

Indirect and Cumulative Effects (ICE) Technical Report

RICHMOND HIGHWAY (ROUTE 1) CORRIDOR IMPROVEMENTS PROJECT BETWEEN JEFF TODD WAY AND NAPPER ROAD, FAIRFAX COUNTY, VIRGINIA



Prepared in support of the Draft Environmental Assessment



VDOT Project #: 0001-029-205, C501, P101, R201

UPC#: 107187

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Appendix A – USGS Historic Topographic Maps

Appendix B – ICE Development Buffer

LIST OF ACRONYMS

ACS	American Community Survey
APE	Area of Potential Effect
BG	Block group
BRT	Bus Rapid Transit
CBC	Community Business Centers
CBPA	Chesapeake Bay Preservation Act
C-CAP	Coastal Change Analysis Program
CCB	Center for Conservation Biology
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLRP	Constrained Long-Range Transportation Plan
CWA	Clean Water Act
DRPT	Department of Rail and Public Transportation
EA	Environmental Assessment
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCDOT	Fairfax County Department of Transportation
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FWIS	Fish and Wildlife Information Service
FY	Fiscal year
GIS	Geographic Information System
HHS	Department of Health and Human Services
HOV	High occupancy vehicle
HUC	Hydrologic Unit Code
ICE	Indirect and Cumulative Effects
IPaC	Information for Planning and Conservation
LID	Low Impact Development
L RTP	Long Range Transportation Plan
MWCOG	Metropolitan Washington Council of Governments
NAICS	North American Industry Classification System
NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act

NETR	Nationwide Environmental Title Research
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
NVTA	Northern Virginia Transportation Authority
NWF	National Wildlife Federation
NWI	National Wetland Inventory
PCB	Polychlorinated Biphenyl
RMA	Resource Management Area
RPA	Resource Protection Area
SFDC	Southeast Fairfax Development Corporation
SOV	Single occupancy vehicle
SUP	Shared Use Paths
SYIP	Six Year Improvement Program
TAZ	Transportation Analysis Zone
TMDL	Total maximum daily load
TRB	Transportation Research Board
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VAC	Virginia Administrative Code
VaFWIS	Virginia Fish and Wildlife Information Service
VDCR	Virginia Department of Conservation and Recreation
VDCR-DNH	Virginia Department of Conservation and Recreation Department of Natural Heritage
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDOT	Virginia Department of Transportation
WERMS	Wildlife Environmental Review Map Service
WMP	Watershed Management Plan
WNS	White Nose Syndrome

1. INTRODUCTION

1.1 PROJECT DESCRIPTION

The Virginia Department of Transportation (VDOT), in cooperation with the Federal Highway Administration (FHWA), is preparing an Environmental Assessment (EA) for the Richmond Highway (Route 1) Corridor Improvements Project between Jeff Todd Way and Napper Road. Improvements are proposed for an approximate 2.9-mile section of Richmond Highway between Route 235 (Mount Vernon Memorial Highway – South) to 0.07 miles north of Route 235 (Mount Vernon Highway – North) at Napper Road. The environmental Study Area extends a little further north along the Richmond Highway to Sherwood Lane (**Figure 1-1**). The EA is being prepared in accordance with the National Environmental Policy Act (NEPA), FHWA regulations at 23 Code of Federal Regulations (CFR) § 771 and Technical Advisory T 6640.8, and Council on Environmental Quality (CEQ) guidance at 40 CFR § 1500 -1508.

Based on historical connections to the state capital in Richmond, Route 1 is also known as the “Richmond Highway”. Richmond Highway is the principal north-south route for local traffic in eastern Fairfax County for shopping and other general-purpose trips, and serves as a major commuter route and an alternate north-south route for nearby Interstate 95 (I-95). The section of Richmond Highway evaluated in this EA is in the southeast portion of Fairfax County between Hybla Valley to the north and Fort Belvoir to the south.

Richmond Highway on either side of the Study Area has six general purpose lanes (**Figure 1-2**). Beginning at the southwest end of the current Study Area at the Mount Vernon Memorial Highway (VA 235)/Jeff Todd Way intersection, a construction project is underway that widens Richmond Highway to six lanes extending 3.68 miles south through Fort Belvoir and ending at Telegraph Road. Richmond Highway has also been previously widened to six general purpose lanes from approximately the Ladson Lane intersection in the northern Study Area, north to I-95/I-495.

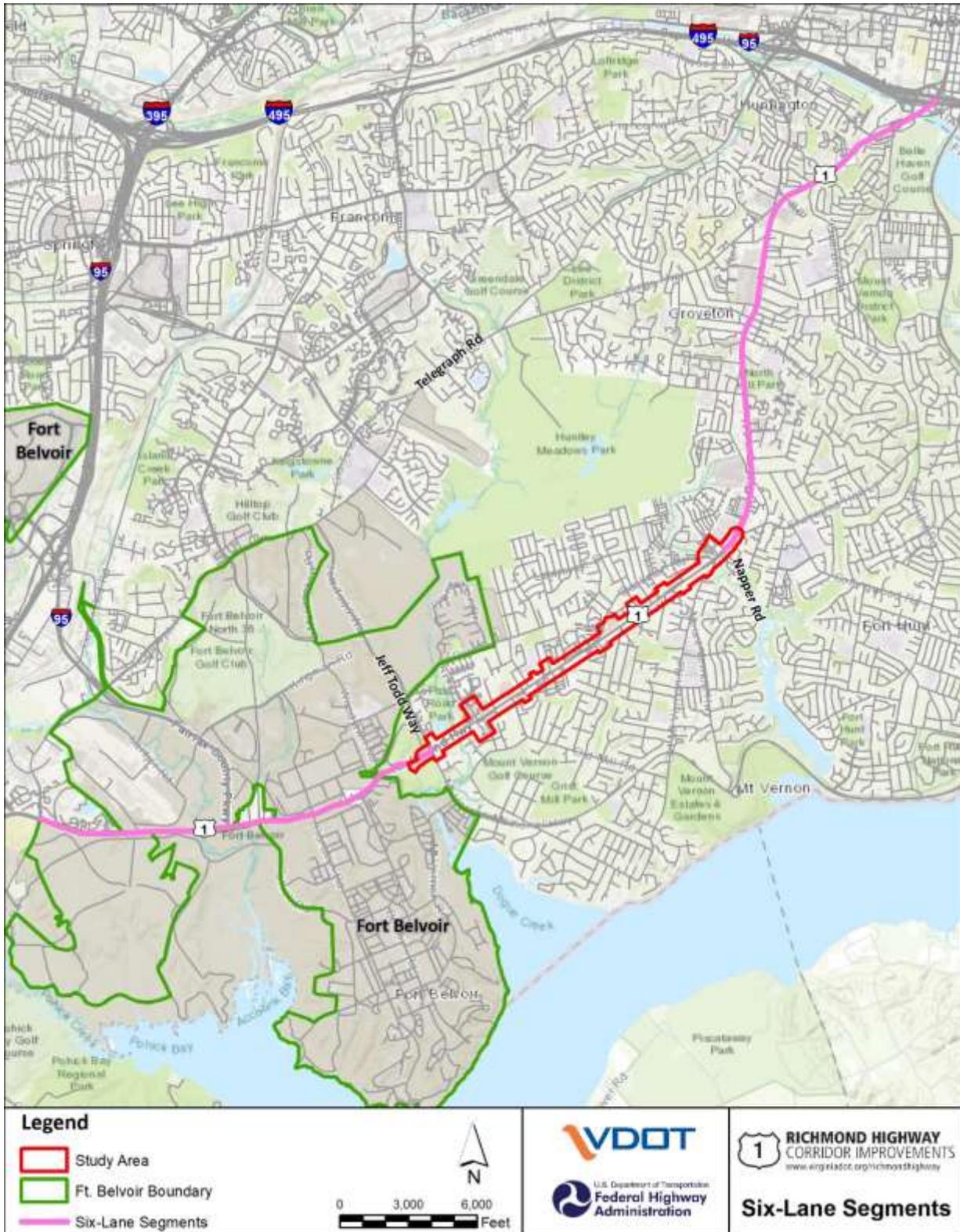
The purpose of this Indirect and Cumulative Effects (ICE) Technical Report is to identify the existing socioeconomic, historic, and natural resources characteristics in the Study Area, then assess the potential impacts of the No-Build and Build Alternative to these resources. This report supports discussions presented in the EA.

- **Section 1** provides an overview of the study.
- **Section 2** summarizes the methods used to identify the ICE resources for the project.
- **Section 3** summarizes the analysis for indirect effects.
- **Section 4** summarizes the cumulative effects.
- **Section 5** provides the references used within the Technical Report.

Figure 1-1: Project Area and Study Corridor



Figure 1-2: Richmond Highway Six-Lane Segments Adjacent to Study Area



1.2 PURPOSE AND NEED

The Richmond Highway Corridor Improvements EA will address the following purpose and needs:

- Accommodate Travel Demand – better accommodate existing and future travel demand at peak travel hours, reducing congestion and increasing corridor accessibility and mobility (including Bus Rapid Transit (BRT) implementation based on the Department of Rail and Public Transportation (DRPT) Multimodal Study and Fairfax County Board of Supervisors Resolution)
- Improve Safety –implement access control; provide adequately spaced signalized intersections; provide turn lanes where needed; improve structures at natural stream crossings; and enhance pedestrian and bicycle facilities

1.3 ALTERNATIVES

1.3.1 No-Build Alternative

The No-Build Alternative includes continued road maintenance and repairs of existing transportation infrastructure within the Study Area. The Metropolitan Washington Council of Governments (MWCOC) Transportation Improvement Program does not have any planned improvement projects listed for Richmond Highway within the Study Area. The MWCOC Constrained Long-Range Plan includes the current study for widening Richmond Highway, and the separate study of future BRT in the Richmond Highway median from the Huntington Metro Station approximately 3.5 miles north of the Study Area, continuing approximately 8 miles south to the Woodbridge Virginia Railway Express Station, consistent with the DRPT Multimodal Study / Fairfax County Board of Supervisors Resolution. For the purposes of this study, the No-Build Alternative does not include either proposed project. The No-Build Alternative serves as the baseline against which the potential environmental effects of the Build Alternative are compared.

1.3.2 Build Alternative

The Build Alternative is generated from the 2015 *US Route 1 Multimodal Alternatives Analysis* Locally Preferred Alternative (Alternative 4 BRT / Metrorail Hybrid) selected by Fairfax County and the DRPT. The identified Build Alternative is to widen Richmond Highway from a four-lane undivided roadway to divided six-lane facility with bicycle and pedestrian accommodations, and a median wide enough to accommodate BRT as called for in the DRPT Multimodal Study / Fairfax County Board of Supervisors Resolution. The median would be maintained as a grass strip until the implementation of the BRT.

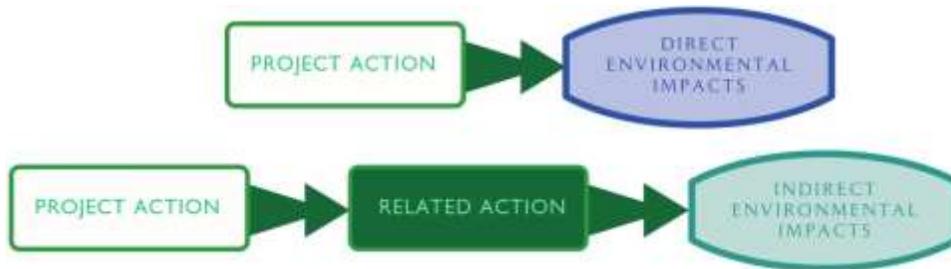
2. METHODOLOGY

2.1 Regulatory Context

NEPA legislation does not mention indirect or cumulative impacts; however, the CEQ regulations for implementing NEPA address federal agency responsibilities applicable to indirect and cumulative considerations, analysis, and documentation (40 CFR 1508.25) in the content requirements for the environmental consequences section of an Environmental Impact Statement (EIS) (40 CFR 1502.16).

CEQ defines indirect effects as “...effects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable” (40 CFR 1508.8(b)). Indirect effects may include “growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems” (40 CFR 1508.8(b)). These induced actions are those that may or may not occur without the implementation of the proposed project, as illustrated in **Figure 2-1**.

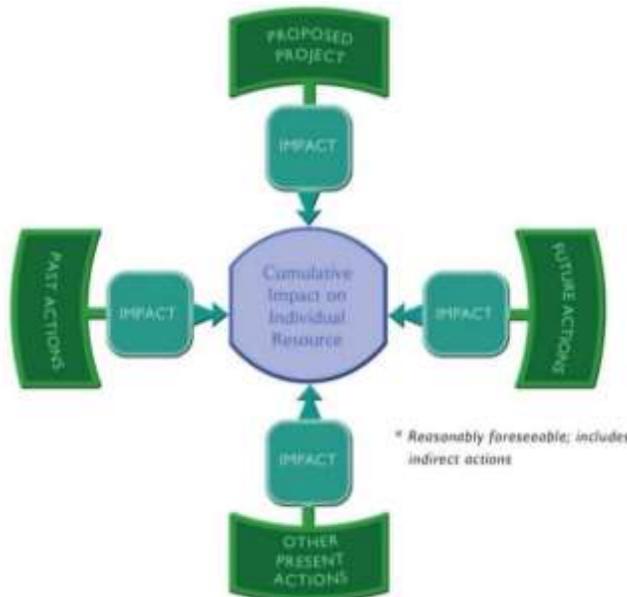
Figure 2-1: Direct vs. Indirect Environmental Impact



Source: *Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process, FHWA, 2014.*

CEQ defines cumulative effects (or impacts) as, “...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time” (40 CFR 1508.7). Cumulative effects include the total of all impacts, direct and indirect, experienced by a particular resource that have occurred, are occurring, and/or would likely occur as a result of any action or influence, including effects of a federal activity (Environmental Protection Agency (EPA), 1999), as illustrated in **Figure 2-2**.

Figure 2-2: Cumulative Impacts



Source: *Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process, FHWA, 2014.*

Because indirect and cumulative effects may be influenced by actions including those taken by others outside of the immediate Study Area, assumptions must be made to estimate the result of these actions. The CEQ regulation, cited above, states that the analysis must include all the indirect effects that are known, and make a good faith effort to explain the impacts that are not known but which are “reasonably

foreseeable.” NEPA does not define what constitutes “reasonably foreseeable actions.” Court decisions on this topic indicate that indirect impact analyses should consider impacts that are sufficiently “likely” to occur (FHWA, 2014). CEQ has provided guidance on how to define reasonably foreseeable actions based upon court opinions. CEQ is clear that actions that are probable should be considered while actions that are merely possible, conceptual, or speculative in nature are not reasonably foreseeable and need not be considered in the context of cumulative effects (CEQ, 1981; FHWA, 2014).

This direction on identifying reasonably foreseeable actions is taken into account in both indirect and cumulative effects analyses described in the following sections. Specific methodologies on how these analyses were conducted are presented below.

2.2 INDIRECT EFFECTS

This section presents an analysis of the potential indirect impacts related to the alternatives described in **Section 1.3**. For the purposes of this Technical Report, the methodology followed for analyzing indirect effects is prescribed in the Transportation Research Board’s (TRB) National Cooperative Highway Research Program (NCHRP) Report 466, *Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects* (TRB, 2002).

In NCHRP Report 466, the TRB states that indirect effects can occur in three broad categories:

1. Encroachment-Alteration Impacts – Alteration of the behavior and functioning of the affected environment caused by project encroachment (physical, biological, socioeconomics) on the environment;
2. Induced Growth Impacts – Project-influenced development effects (land use); and,
3. Impacts Related to Induced Growth – Effects related to project-influenced development effects (impacts of the change of land use on the human and natural environment).

For the purpose of this analysis, the term “indirect effects” refers to all three of these categories. Transportation improvements often reduce time and cost of travel, as well as provide new access to properties, enhancing the attractiveness of surrounding land to developers and consumers (North Carolina Department of Transportation (NCDOT), 2001). Development of vacant land, or conversion of the built environment to more intensive uses, is often a consequence of highway projects. Important characteristics for induced growth are described in NCDOT’s *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina, Vol. II: Practitioners Handbook* (NCDOT, 2001). These characteristics include existing land use conditions in the project area, increased accessibility that may result from new transportation improvements, local political and economic conditions, the availability of other infrastructure, and the rate of urbanization in the region. The Study Area is highly developed and is therefore likely to experience infill development and redevelopment of existing facilities, rather than suburban/urban sprawl (NCDOT, 2001).

The indirect effects analysis focuses on the potential for ecological and socioeconomic impacts that could occur as a result of the proposed alternatives outside of the area of direct impact, as well as the potential impacts of redevelopment. The stepwise process TRB recommends in NCHRP Report 466 for assessing indirect effects has been used as the structure for this analysis, and consists of the following steps:

- Step 1 Scoping;
- Step 2 Identify Study Area Direction and Goals;

- Step 3 Inventory Notable Features in the Study Area;
- Step 4 Identify Impact-Causing Activities of the Build Alternatives;
- Step 5 Identify Indirect Effects for Analysis;
- Step 6 Analyze Indirect Effects and Evaluate Analysis Results; and,
- Step 7 Assess Consequences and Develop Mitigation.

To complete these steps, the required analysis relies on planning judgment that is described in the NCHRP 25-25 program, Task 22, *Forecasting Indirect Land Use Effects on Transportation Projects* (TRB, 2007). The direction provided in the TRB document is the basis for the indirect effects analyses presented in this Technical Report.

2.3 CUMULATIVE EFFECTS

To document cumulative effects for this study, the analysis followed the five-part evaluation process outlined in *Fritiofson v. Alexander*, 772 F.2d 1225 (5th Cir., 1985), as described in FHWA's *Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process* (FHWA, 2014):

1. What is the geographic area affected by the study?
2. What are the resources affected by the study?
3. What are the other past, present, and reasonably foreseeable actions that have impacted these resources?
4. What are those impacts?
5. What is the overall impact on these various resources from the accumulation of the actions?

Each of these parts of the cumulative effects evaluation process is discussed in **Section 4** of this Technical Report.

3. INDIRECT EFFECT ANALYSIS

3.1 STEP 1: SCOPING

The first step in the indirect effects analysis includes scoping activities and the identification of the Study Area in order to set the stage for the remaining steps. As part of this scoping effort, a number of planning documents prepared by the locality in the Study Area were reviewed, including the *Fairfax County Comprehensive Plan* and its Amendments, and the *Fairfax County Bicycle Master Plan* (Fairfax County, 2013a, 2014, 2015b, and 2016c). These documents illustrate that the proposed improvements have been considered in the local and regional planning processes for some time.

Scoping also included agency coordination. VDOT mailed scoping letters to the following federal, state, and local agencies and organizations to obtain pertinent information and to identify key issues regarding the potential environmental impacts for this study:

- Commonwealth Transportation Board, Northern Virginia District
- Fairfax County Department of Housing and Community Development
- Fairfax County Department of Neighborhood and Community Services
- Fairfax County Department of Planning and Zoning
- Fairfax County Department of Public Works and Environmental Services
- Fairfax County Department of Transportation

- Fairfax County Economic Development Authority
- Fairfax County Executive
- Fairfax County Fire and Rescue Department
- Fairfax County Health Department
- Fairfax County Park Authority
- Fairfax County Planning Commission
- Fairfax County Police Department
- Fairfax County Public Schools
- Fairfax County Water Authority
- Metropolitan Washington Council of Governments
- Federal Highway Administration, Eastern Federal Lands Highway Division
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Habitat Conservation Division
- Northern Virginia Regional Commission
- Northern Virginia Regional Park Authority
- Southeast Fairfax Development Corporation
- The Historical Society of Fairfax County
- United States Army Corps of Engineers, Norfolk District
- United States Army Garrison, Fort Belvoir, Directorate of Public Works
- United States Department of Agriculture, Natural Resources Conservation Service
- United States Department of Homeland Security, Federal Emergency Management Agency
- United States Department of Housing and Urban Development, Richmond Field Office
- United States Department of the Interior, Fish and Wildlife Service
- United States Department of the Interior, National Park Service, National Capital Region
- United States Department of the Interior Office of Environmental Policy and Compliance
- United States Department of Transportation, Federal Transit Administration
- United States Environmental Protection Agency
- Virginia Department of Agriculture and Consumer Services
- Virginia Department of Conservation and Recreation, Department of Natural Heritage
- Virginia Department of Conservation and Recreation, Recreational Planning
- Virginia Department of Conservation and Recreation, Soil and Water Conservation
- Virginia Department of Environmental Quality, Environmental Impact Review
- Virginia Department of Forestry
- Virginia Department of Game and Inland Fisheries, Environmental Services Section
- Virginia Department of Health, Office of Drinking Water
- Virginia Department of Historic Resources, Office of Review and Compliance
- Virginia Department of Housing and Community Development

- Virginia Department of Mines, Minerals and Energy, Division of Geology and Mineral Resources
- Virginia Marine Resources Commission
- Virginia Outdoors Foundation
- Washington Metro Area Transit Authority

Scoping letters were customized to specifically ask appropriate parties questions regarding indirect and cumulative effects. The information obtained through these efforts was used to further define the direction and goals of the region, as well as the resources included in the Study Area. Additional details on the scoping process and responses can be found in the associated EA, **Section 4.0 Coordination and Comments**.

3.2 STEP 2: IDENTIFY STUDY AREA DIRECTION AND GOALS

The second step in the indirect effects analysis focuses on assembling information about general trends and goals within the Study Area.

3.2.1 Study Areas

The Study Area for this EA, along with input from the scoping process outlined above, was used to identify resource-specific Study Areas for this indirect effects analysis. Specific indirect effect Study Areas were developed for each or the following resource topics:

- **Socioeconomic Resources:** This Study Area was established to analyze indirect effects to communities, community facilities, bike paths and recreational trails, population and housing characteristics, environmental justice (EJ) populations, and land use and locality plans. The Socioeconomic Resources ICE Study Area is the same as the environmental Study Area and is generally defined as 300 feet on either side of the existing Richmond Highway centerline, with additional areas extending as much as 1,000 feet for access management (**Figure 3-1**). The socioeconomic analysis includes Census block groups that intersect the environmental study corridor.
- **Natural Resources:** This Study Area was established to analyze the indirect effects to water resources, floodplains, wildlife habitat, and threatened, endangered, and special status species. The Natural Resources ICE Study Area is based on the Virginia Department of Conservation and Recreation (VDCR) and the Virginia Hydrologic Unit Explorers subwatershed 12-digit Hydrologic Unit Code (HUC) determinations, including all HUCs that are within or partially within the Study Area. HUCs that cross the Potomac River into Maryland were cut at the state line, because projects that occur within the portion of the HUC in Virginia would not affect the Maryland portion of the HUC. The Potomac River is the lowest point in the watershed that could be affected by the project; therefore, it is unlikely that implementation of the project would cause indirect effects upstream into the Maryland portion of the watershed (**Figure 3-2**).
- **Historic Resources:** This Study Area was established to analyze indirect effects to historic resources, such as accessibility during construction and changes to visitation. The Historic

Figure 3-1: Socioeconomic Resources ICE Study Area

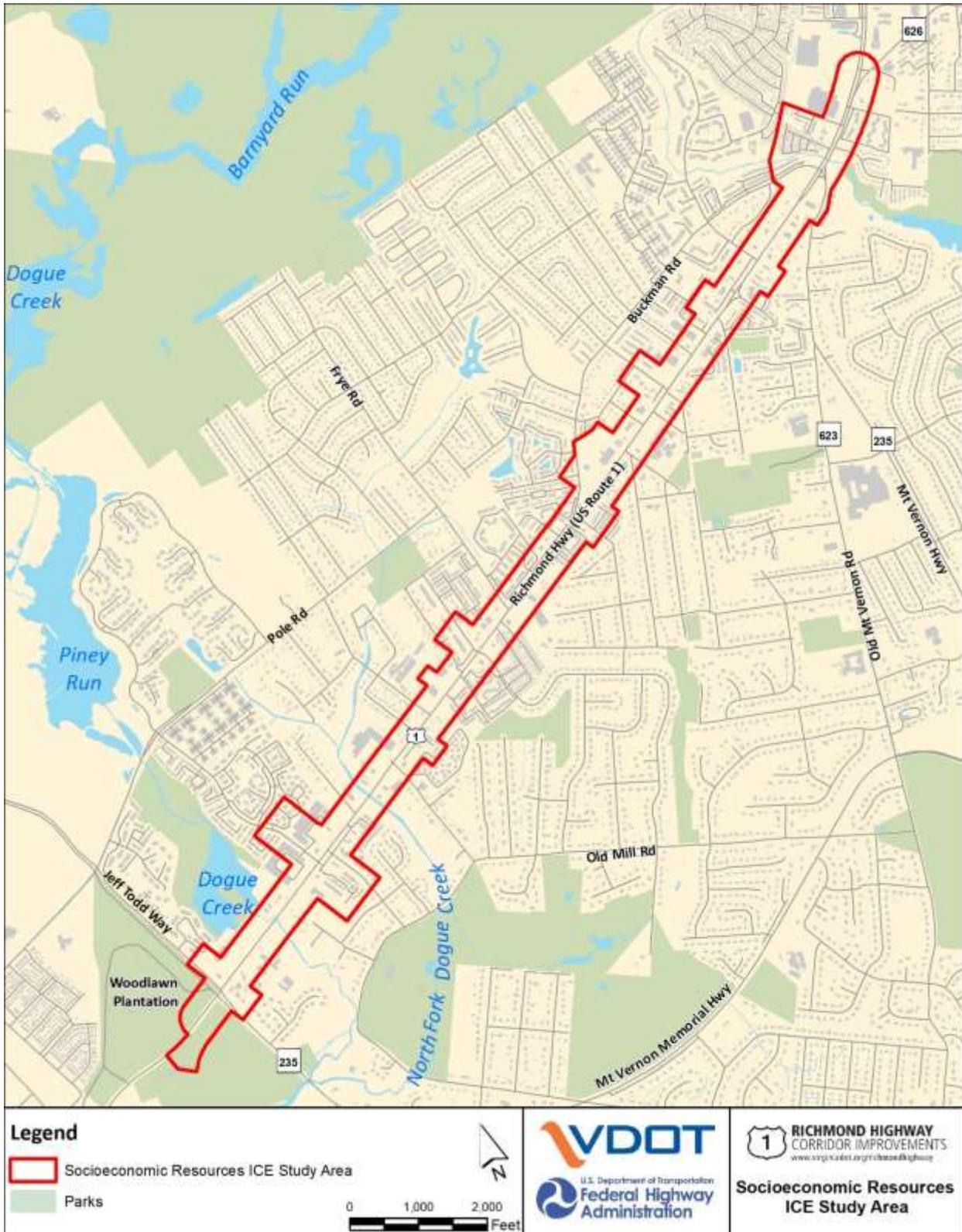
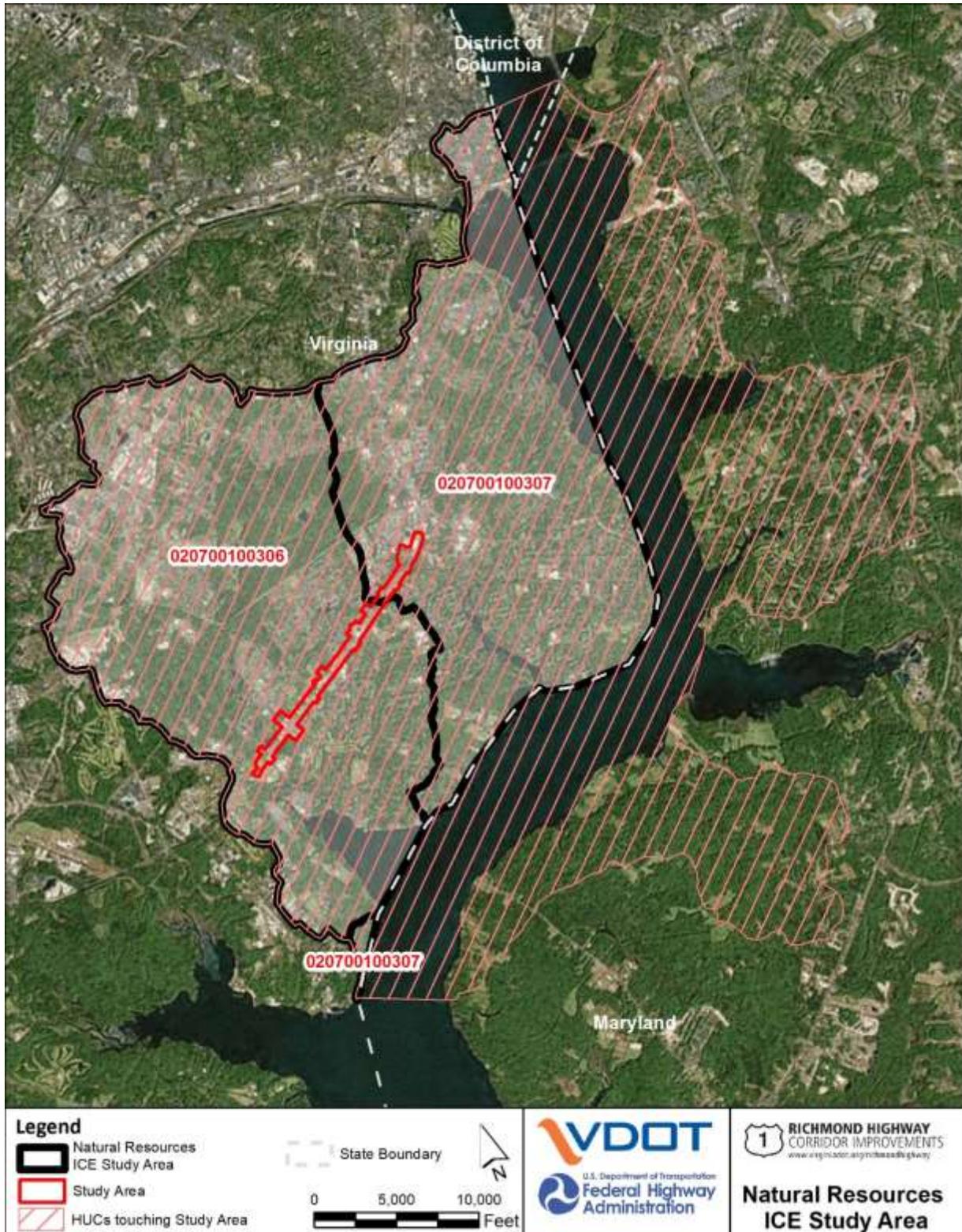


Figure 3-2: Natural Resources ICE Study Area



Resources ICE Study Area is the Area of Potential Effect (APE) as defined for the undertaking (**Figure 3-3**). No ICE Study Areas for air quality or noise are defined. The indirect and cumulative effects of the Build Alternative are evaluated in the *Richmond Highway Air Quality Technical Report* and take into account air quality impacts for a large part of the region in the future (VDOT, 2017a). Potential noise effects are evaluated for the Build Alternative’s alignment in the *Richmond Highway Noise Technical Report* that incorporates the existing cumulative ambient noise environment with contributions from all sources including aircraft, railroads, and ships (regardless of where these sources are located) (VDOT, 2017c). Mitigation for noise impacts are based on the forecasted noise levels in the design year. In addition, environmental resource impact trends and protection goals within the Natural Resources ICE Study Area and Historic Resources ICE Study Area are discussed.

3.2.2 Directions and Goals

The directions and goals considered for the analysis are independent of the transportation alternatives being evaluated in the EA and include social, economic, growth-related, and natural and historic resource-related issues. Evidence indicates that transportation investments result in land use changes only in the presence of other factors. These factors include supportive local land use policies, local development incentives, availability of developable land, and a favorable investment climate (TRB, 2002). An understanding of local goals combined with a thorough knowledge of demographic, economic, and social trends is essential in understanding the potential for project-influenced changes.

Understanding the regional goals is also important for consideration of potential indirect effects to the natural environment and whether potential effects are in line with local goals as a determinant of impact significance and an indicator of effects that merit further analysis. The following sections describe the existing and planned land use and population/employment trends in the ICE Study Areas in order to provide insight to the direction and goals for the Study Area.

Historic Land Use

The Socioeconomic Resources ICE Study Area follows the route of Richmond Highway (Route 1). Richmond Highway was fully paved in 1927. The traffic volume on Richmond Highway was impacted by the expansion of northern Virginia and the resumption of automobile production after World War II in 1946 (VDOT, 2006). By 1955 automobile production had quadrupled (GMW, 2012). At that time, Richmond Highway was the primary traveled through road in Virginia, since Interstate 95 (I-95) was not built until 1957 (VDOT, 2006).

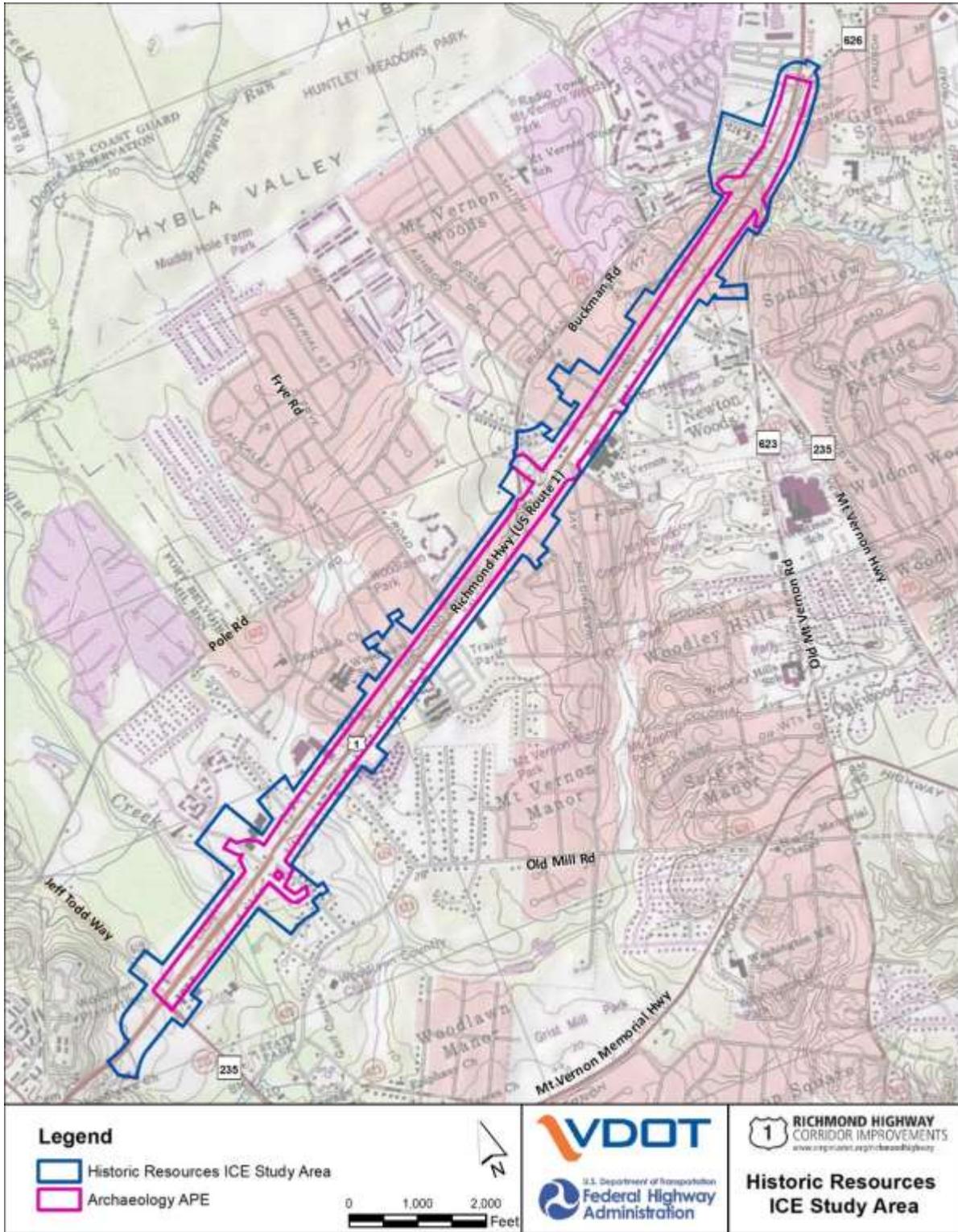
Table 3-1 shows the substantial population increase within Fairfax County between 1940 and 1960 with population increasing more than six times over the 1940 population. This growth has continued, although at a slower pace than occurred between 1940 and 1960 (US Census, 1990; US Census, 2000; ACS, 2010).

Table 3-1: Historic Populations

Locality	1940	1950	1960	1970	1980	1990	2000	2010
Fairfax County	40,929	98,557	275,002	454,275	569,901	818,584	969,749	1,086,743
10 Year Growth %	--	141%	179%	65%	31%	37%	19%	12%
Virginia	2,677,773	3,318,680	3,966,949	4,651,448	5,346,797	6,187,358	7,078,515	8,024,617
10 Year Growth %	--	24%	20%	18%	15%	16%	14%	13%

Source: US Census Bureau Population and Housing (US Census, 1990), US Census Profile of General Demographic Characteristics (US Census, 2000) American Community Survey Total Population (ACS, 2010)

Figure 3-3: Historic Resources ICE Study Area



The Pentagon and Henry G. Shirley Memorial Highway (I-395) were constructed around 1943, adding to the growing infrastructure of northern Virginia. Additionally, the number of apartment communities within Arlington County were expanding during the 1930s. The communities were filled by 1942, pushing suburbanization south of Washington, DC, and impacting traffic on Richmond Highway in the Study Area. The 1951 United States Geological Survey (USGS) topographic map shows the increase in development surrounding Richmond Highway for about 1,000 feet to either side, and on feeder roads in the area (**Appendix A**). To reduce traffic volumes on Richmond Highway, I-95 was constructed in 1957 as part of the Interstate Highway System, which was authorized by the Federal Aid Highway Act of 1956. By 1962, approximately half of the Study Area surrounding Richmond Highway was covered in housing and development. By 1965, the 71-mile section of I-95 was open, thus completing a connection between the Richmond and Petersburg areas and Washington, DC. Between 1970 and 1995, the number of acres in the Study Area in nonresidential land uses (excluding public facilities) quadrupled, expanding by 463 percent. Office development was the dominant form of nonresidential growth in Fairfax County during the 1970s and 1980s. At the same time, the number of acres in residential land use in the county grew by 168 percent (Fairfax County, 2015a). The development in the Socioeconomic Resources ICE Study Area had a sustained increase in developed lands as can be seen in the 1983 USGS topographic map. Other than in Fort Hunt Park and areas surrounding Mount Vernon which have forest cover, the 1994, 1997, and 2002 historic aerials and imagery show an urbanized area.

Land Use Patterns and Local Plans

The following section describes the local plans that guide the future changes to land use patterns and other development within the Socioeconomic Resources ICE Study Area. Additional information is available in the *Richmond Highway Socioeconomics and Land Use Technical Report* (VDOT 2017d).

In Fairfax County, zoning implements the land use plan. Overall, the majority of Fairfax County is residential land use, followed by recreation and open space and institutional, government and utilities (Fairfax County, 2016c). Fairfax County recently revised zoning (adopted in June of 2016) to allow for the density referred to in the *Comprehensive Plan* (Fairfax County, 2016c). Increased densities and mixed use would primarily occur in “mixed use centers” or “alternative use areas.” The Socioeconomic Resources ICE Study Area contains a greater amount of commercial land use and a smaller amount of residential land use than is typical for the county. In the Socioeconomic Resources ICE Study Area, increased density and mixed use zoning changes would occur near “alternative use,” “mixed use centers,” “retail and other commercial uses,” or “residential” uses (Fairfax County, 2016a).

The Socioeconomic Resources ICE Study Area is located in the Mount Vernon Planning District, with three Community Business Centers identified with potential for medium density and intensity development and a portion identified in the Enhanced Public Transportation Corridor for major public transportation facility updates (Fairfax County, 2013a).

The *Fairfax County Comprehensive Plan* notes that the county “should have a land use pattern which increases transportation efficiency, encourages transit use, and decreases automobile dependency” (Fairfax, 2013a). Fairfax wishes to “concentrate most future development in mixed-use centers, transit station areas and areas of transportation advantage” (Fairfax, 2013a). Fairfax also notes that due to rapid growth over the past decades, the amount of available vacant land (currently 1 percent) is diminishing and redevelopment would be more prevalent in the future. The County supports “a multi-modal transportation system that provides transportation choices, reduces [single occupancy vehicle] [SOV] use”

and “provides [high occupancy vehicle] [HOV] lanes on freeways and major arterials where substantial travel benefits can be realized” (Fairfax County, 2013a).

The *Fairfax County Comprehensive Plan* identifies the need to balance residential, commercial, and industrial growth with supporting transportation infrastructure (Fairfax County, 2013a). Current zoning maps for Fairfax County support the existing land uses and potential infill and redevelopment within the Socioeconomic Resources ICE Study Area.

Future Population Projections

The Metropolitan Washington Council of Governments (MWCOG) and supporting jurisdictions and planning agencies produce Cooperative Forecasts containing employment, population, and household projections by Transportation Analysis Zones (TAZ) in the Washington region. A series of forecasts constitutes a “Round”; Round 9.0 covers the time period from 2015 to 2045. The Socioeconomic Resources ICE Study Area contains 13 TAZs – 2069, 2074, 2075, 2076, 2077, 2079, 2080, 2081, 2082, 2083, 2084, 2085, and 2086.

The population increase for Fairfax County between 2015 and 2045, of 7 to 8 percent per decade, is lower than the historic trends identified in **Table 3-1**, likely due to the slowing of development in a highly developed area (**Table 3-2**). The population increase for the TAZs that are within or partially within the Socioeconomic Resources ICE Study Area are lower than the county’s, with 3 to 7 percent per decade. Both Fairfax County and the Socioeconomic Resources ICE Study Area have an anticipated steady increase in population from 2015 to 2045 (MWCOG, 2016a).

Table 3-2: Future Population Forecasts

Geographic Area	2015	2025	2035	2045
TAZs within or partially within Socioeconomic Resources ICE Study Area	41,797	42,985	45,821	48,436
10 Year Growth %	-	3%	7%	6%
Fairfax County	1,125,400	1,213,200	1,314,300	1,406,700
10 Year Growth %	-	7%	8%	7%

Source: MWCOG Cooperative Forecast-Round 9.0, (MWCOG, 2016a)

Economic Development and Employment

Washington, DC, Montgomery County, MD, and Fairfax County, VA are predicted to add the largest number of new jobs to the region’s employment base by 2045 (MWCOG, 2016a). Employment within the Study Area is largely dependent on the professional, scientific, management, administrative, and waste management industry. The increase in employment in Fairfax County and in the Socioeconomic Resources ICE Study Area is consistent with the increased density and intensity of development anticipated in the Mount Vernon District (Fairfax County, 2013a).

The TAZs that are within or partially within the Socioeconomic Resources ICE Study Area have a higher employment percentage change (82 percent) than that of Fairfax County (37 percent) from 2015 to 2045 (**Table 3-3**).

Table 3-3: Employment Forecasts

Geographic Area	2015	2025	2035	2045
Total of TAZs within or partially within Socioeconomic Resources ICE Study Area	10,777	12,672	16,354	19,577
10 Year Growth %	-	18%	29%	20%
Fairfax County	654,100	749,300	827,800	898,100
10 Year Growth %	-	13%	9%	8%

Source: MWCOG Cooperative Forecast-Round 9.0, (MWCOG, 2016a)

Natural Resources Protection/Ecosystems

The Natural Resources ICE Study Area encompasses portions of two 12-digit HUC subwatersheds, which drain to the Potomac River and are a part of the Chesapeake Bay estuary. The Study Area underwent a period of rapid urban development from the 1920s to the 1980s, resulting in the loss of the majority of the natural ecosystems that were historically present (Fairfax County Park Authority, 2014). The remaining natural areas are now largely restricted to the major stream corridors, which have received higher levels of protection since the 1980s. The Clean Water Act of 1972 (CWA), the Chesapeake Bay Preservation Act (CBPA), and various state and local erosion and sedimentation control, stormwater management, floodplain management, and land disturbance regulations afford current legal protections to the majority of the remaining natural areas.

The CWA provides water quality, wetland, and stream protections, which are administered and enforced by the EPA, US Army Corps of Engineers (USACE), and Virginia Department of Environmental Quality (VDEQ). The CBPA provides protections for riparian habitats that buffer wetlands and streams through the designation of Resource Protection Areas (RPA) and Resource Management Areas (RMA). The RPA encompasses a 100-foot buffer beyond the wetland or stream boundary, or a stream's major floodplain. Development within the RPA is limited to water dependent activities or redevelopment of existing developed areas. Administration and enforcement of the CBPA protections is carried out by the individual counties or cities that lie within the Chesapeake Bay Preservation Area. The RMA encompasses all additional areas beyond the RPA that have the potential to impact water quality. Allowable development activities in the RMA are not as restrictive as in the RPA; however, coordination with the county or city is still required for activities in these areas prior to development.

Since the majority of the wildlife habitat in the Natural Resources ICE Study Area lies within the stream corridors and their floodplains, wildlife and wildlife habitat also receive protection through the CWA and the CBPA. Threatened, endangered, and special status species, if present, receive direct protection through federal or state endangered species laws.

Conservation management and protection of the remaining natural areas within the Natural Resources ICE Study Area are guided by local natural resources management plans. These plans establish goals for the management, restoration, and protection of the remaining natural areas. Since land available for acquisition and conversion from a developed condition back to a natural condition is very limited, restoration activities are largely focused on managing existing impacted natural resources to improve their overall condition and habitat values. Such activities include invasive species management actions, replanting with native species, and restoration of degraded streams and wetlands.

3.3 STEP 3: INVENTORY OF SENSITIVE RESOURCES IN THE STUDY AREA

Sensitive resources for this study that were considered to be particularly relevant for the analysis of impacts from a transportation project include socioeconomics (including communities and community facilities, population characteristics, economics, and land use); natural resources (including streams, wetlands, water quality, floodplains, wildlife habitat, and threatened, endangered, and special status species); and historic resources.

3.3.1 Socioeconomic Resources

Communities and Community Facilities

Communities

The Study Area is in southeastern Fairfax County. The *Fairfax County Comprehensive Plan (2013)* divides the county into four primary planning areas, with further subdivisions into districts and sectors. The Study Area is located entirely within the Mount Vernon Planning District (**Figure 3-4**). The Planning Districts contain site-specific guidance that implement the countywide Policy Plan, which includes the Fairfax County Concept for Future Development. Planning Sectors contain guidance on the specific uses, ranges of residential density or land use intensity, as well as alternative or optional uses for certain tracts of land in the sector.

The Mount Vernon Planning District is generally bordered by I-495/I-95 to the north, the Potomac River to the east, Dogue Creek to the South, and Huntley Meadows Park to the west. This District is diverse in character with the Huntington Metro Station located to the north and Fort Belvoir to the southwest. Richmond Highway bisects this Planning District as a major north-south corridor. Most of this District contains single-family homes, except along Richmond Highway where there are high-density residential developments as well as commercial activity centers, including community/neighborhood shopping centers and strip malls.

Within the Mount Vernon Planning District, the following Planning Sectors in the Socioeconomic Resources ICE Study Area are considered “communities” for the purposes of this study: Mount Vernon, Woodlawn, Hybla Valley, Groveton, and Fort Hunt (**Figure 3-4**). Richmond Highway forms part of the boundaries of the planning sectors described above. Widening of the Richmond Highway and miscellaneous frontage roads over time has incrementally separated the adjacent communities to either side.

Community Facilities

Community facilities considered and identified within the Socioeconomic Resources ICE Study Area include cemeteries, fire stations, medical facilities, libraries, community centers / non-profits, police stations, post offices, religious facilities, schools/universities, publicly-owned parks, and outdoor recreational facilities (**Figure 3-5** and **Table 3-4**). Community facilities in the Socioeconomic Resources ICE Study Area were identified through a review of Fairfax County Geographic Information System (GIS) data and online mapping.

Figure 3-4: Study Area and Community Planning Sectors

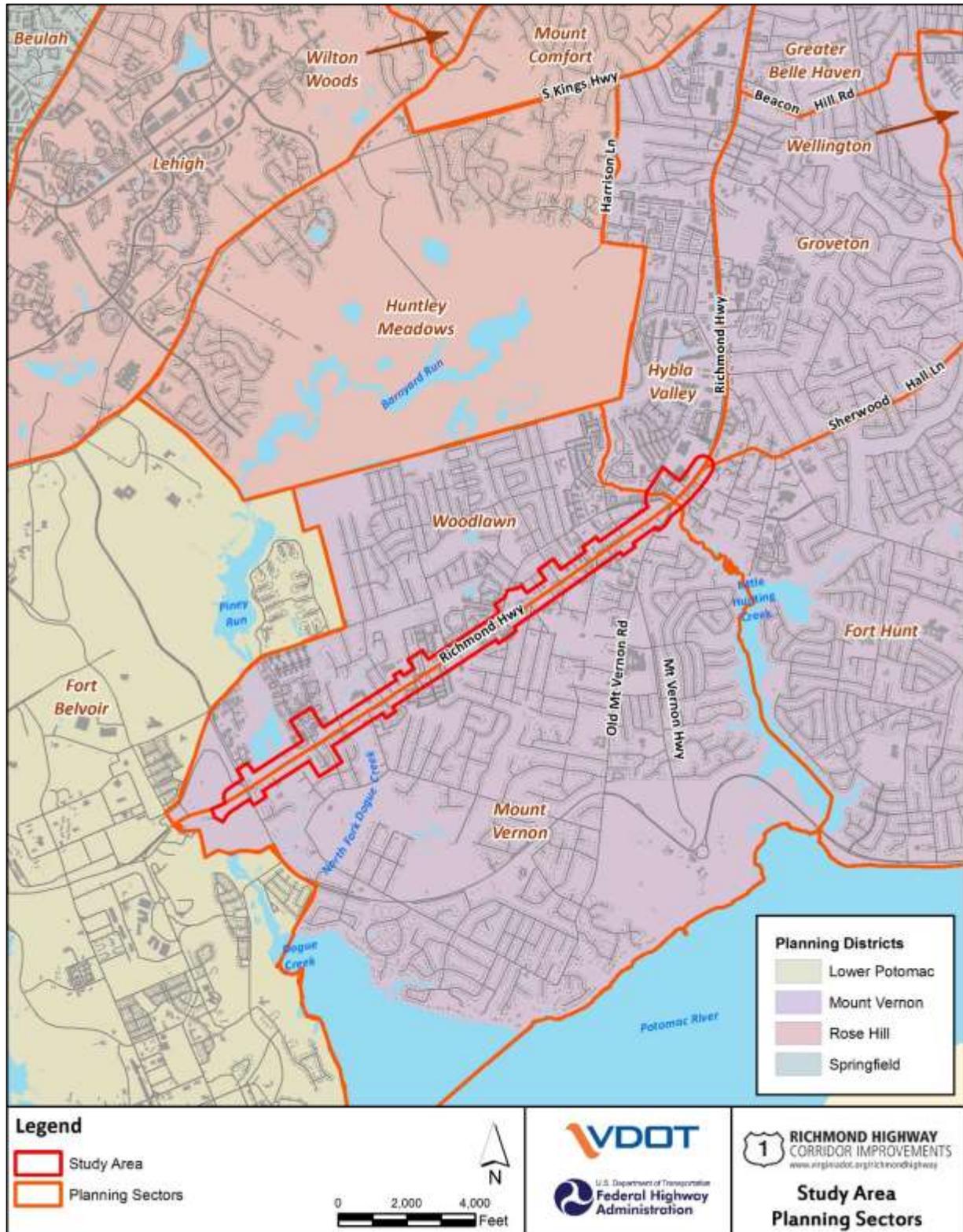


Figure 3-5: Community Facilities within the Socioeconomic Resources ICE Study Area

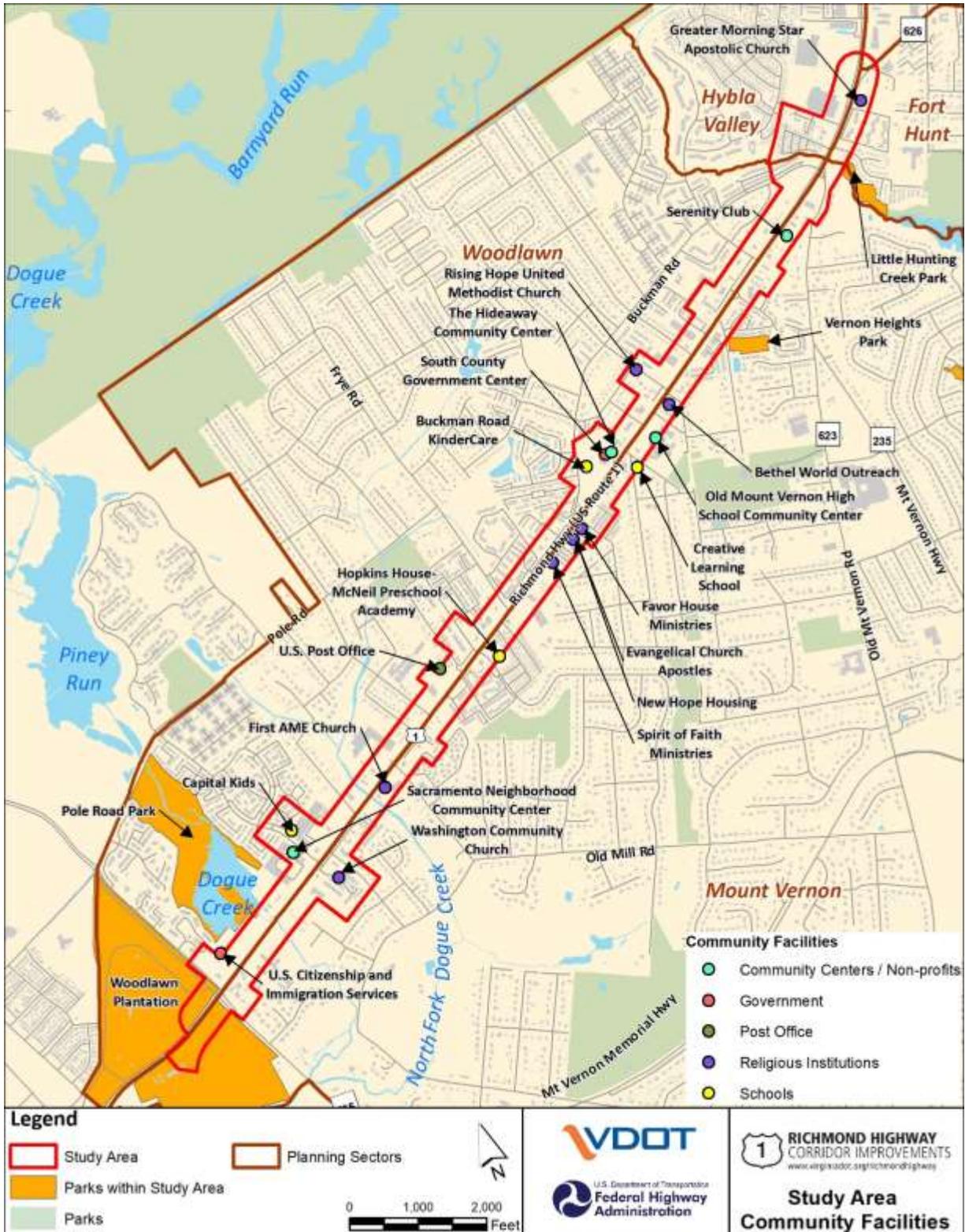


Table 3-4: Community Facilities

Facility	Address/Community
Schools	
Creative Learning School	8331 Washington Avenue / Mount Vernon
Buckman Road KinderCare	4287 Buckman Road / Woodlawn
Hopkins House-McNeil Preschool Academy	8543 Forest Place / Mount Vernon
Capital Kids Preschool and Learning Center	8758 Richmond Highway / Woodlawn
Post Office	
Engelside United States Post Office	8588 Richmond Highway / Woodlawn
Parks	
Little Hunting Creek Park	Richmond Highway/George Washington Memorial Parkway / Fort Hunt & Mount Vernon
Vernon Heights Park	8225 Central Avenue / Mount Vernon
Pole Road Park	5701 Pole Road / Woodlawn
Woodlawn Plantation	9000 Richmond Highway / Woodlawn & Mount Vernon
Religious Institutions	
First A.M.E. Church	8653 Richmond Highway / Mount Vernon
Spirit of Faith Ministries	8431 Richmond Highway / Mount Vernon
Evangelical Church Apostles	8401 Richmond Highway / Mount Vernon
Favor House Ministries	8400 Radford Avenue / Mount Vernon
Rising Hope Mission Church	8220 Russell Rd / Woodlawn
Bethel World Outreach Church	8305 Richmond Highway / Woodlawn
Greater Morning Star Apostolic Church	7929 Richmond Highway / Fort Hunt
Washington Community Church	8800-C Pear Tree Village Court / Mount Vernon
Government	
South County Government Center	8350 Richmond Highway / Woodlawn
United States Citizenship and Immigration Services – Application Support Center	8850 Richmond Highway Suite 100 / Woodlawn
Community Centers / Non-profits	
Sacramento Neighborhood Community Center (non-profit)	8792 Sacramento Dr Suite E
Serenity Club Inc (non-profit AA)	8121 Richmond Highway / Woodlawn
New Hope Housing Inc.	8407 Richmond Highway E / Mount Vernon
Old Mount Vernon High School Community Center	8333 Richmond Highway / Mount Vernon
Hideaway Teen Center	8350 Richmond Highway / Woodlawn

Source: Fairfax County GIS (Fairfax County, 2016b)

Bike Paths and Recreational Trails

In addition to the identified parks, there are eight bike routes and one recreational trail within the Socioeconomic Resources ICE Study Area, all identified from Fairfax County GIS and planning documents (Figure 3-6).

Figure 3-6: Socioeconomic Resources ICE Study Area Bike Routes and Recreation Trails



Population Characteristics

According to the 2010 US Decennial Census data, the population of the Census block groups in the Socioeconomic Resources ICE Study Area is approximately 30,934 (2.9 percent of Fairfax County population and less than 1.0 percent of Virginia population) (US Census, 2010). Available housing within the Socioeconomic Resources ICE Study Area Census block groups ranges from single-family homes and townhouses to apartments and mobile homes. An estimated 11,424 housing units are in the Socioeconomic Resources ICE Study Area Census block groups. Of those, 10,615 (92.9 percent) are occupied. Within the Socioeconomic Resources ICE Study Area Census block groups, 52.2 percent of the occupied units are owned and the other 47.8 percent are rented. In comparison, Fairfax County has a 67.7 percent owner occupancy rate and Virginia has a 66.2 percent owner occupancy rate.

Environmental Justice Populations

Minority Populations

In accordance with the terms of CEQ guidance, Environmental Justice Guidance under NEPA (1997), an area is identified as containing a minority population where either (a) the minority population of the affected area exceeds 50 percent of total population; or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis. (CEQ, 1997). For the purposes of this study, the minority population for a study Census block group will be found to be “meaningfully greater” than surrounding study block groups if its minority population is greater than the value of the block group with the lowest percentage of minority population within the study Census block groups, plus an additional 10 percent of that value. This methodology has been agreed upon by the Environmental Protection Agency (EPA), FHWA, and VDOT, as appropriate, for the identification of minority populations for discussion within NEPA documents.

Table 3-5 presents the race and ethnicity data of residents in the Socioeconomic Resources ICE Study Area Census block groups according to the 2010 US Decennial Census data. The table also identifies those that meet the definition of a minority population. The “meaningfully greater” threshold for racial minority populations was set at 19.6 percent based on Census block group 4161.00 BG 1 having the lowest minority population of 17.8 percent (17.8 percent plus an additional 10 percent (1.8 percent) equals 19.6 percent). Based on this threshold, 14 of the 15 study Census block groups meet the definition of racial minority populations. The “meaningfully greater” threshold for Hispanic/Latino populations was set at 6.2 percent based on Census block group 4161.00 BG 1 having the lowest Hispanic/Latino population of 5.6 percent. Based on this threshold, 14 of the 15 Study Area Census block groups meet the definition of a Hispanic/Latino population (**Figure 3-7**). The only Census block group (4161.00 BG 1) that does not meet the threshold of having a minority population is located in the southwestern portion of the Study Area near the Mount Vernon Country Club.

Low-Income Populations

Low-income populations are identified where the median household income for a study Census block group is at or below the Department of Health and Human Services (HHS) poverty threshold for a family of four. On average, occupied households in the study Census block groups are inhabited by 2.8 persons. This analysis uses the HHS four-person family poverty level to conservatively identify low-income populations in the study Census block groups. While the 2016 HHS poverty threshold data is available, the 2015 data set is the appropriate data set for a comparison with the Census’s median household income data in 2015 inflation-adjusted dollars.

Table 3-5: Census Block Group, County, and State Minority or Low-Income Populations within the Socioeconomic Resources ICE Study Area

Geographic Areas / Block Groups	Total Population	Minority Population	EJ Threshold	Hispanic Population	EJ Threshold	Median Household Income	Poverty Threshold (4 Persons/Household)	EJ Population
4154.02 BG 3	1,013	56.8%	19.6%	19.1%	6.2%	\$75,192	\$24,250	Yes
4155.00 BG 4	1,459	84.1%	19.6%	11.3%	6.2%	\$26,739	\$24,250	Yes
4159.00 BG 2	2,224	18.4%	19.6%	9.7%	6.2%	\$154,408	\$24,250	Yes
4160.00 BG 1	1,679	49.7%	19.6%	15.6%	6.2%	\$121,100	\$24,250	Yes
4160.00 BG 2	3,047	46.5%	19.6%	27.5%	6.2%	\$61,250	\$24,250	Yes
4161.00 BG 1	2,535	17.8%	19.6%	5.6%	6.2%	\$146,719	\$24,250	No
4215.00 BG 2	3,028	59.5%	19.6%	66.8%	6.2%	\$41,855	\$24,250	Yes
4215.00 BG 3	1,884	80.8%	19.6%	38.0%	6.2%	\$25,957	\$24,250	Yes
4216.00 BG 2	2,026	80.9%	19.6%	32.8%	6.2%	\$49,668	\$24,250	Yes
4216.00 BG 3	1,631	77.3%	19.6%	36.6%	6.2%	\$49,688	\$24,250	Yes
4217.01 BG 1	2,966	67.2%	19.6%	51.4%	6.2%	\$51,406	\$24,250	Yes
4217.01 BG 2	1,580	64.3%	19.6%	34.5%	6.2%	\$74,667	\$24,250	Yes
4218.00 BG 1	1,965	62.2%	19.6%	19.6%	6.2%	\$73,074	\$24,250	Yes
4218.00 BG 2	2,608	68.1%	19.6%	38.4%	6.2%	\$67,163	\$24,250	Yes
4218.00 BG 3	1,289	54.2%	19.6%	19.5%	6.2%	\$73,538	\$24,250	Yes
Study Block Groups Total	30,934	57.7%		30.8%		\$67,163		
Fairfax County	1,081,726	37.3%		15.6%		\$112,552		
Virginia	8,001,024	31.4%		7.9%		\$65,015		

Source: US Census Bureau Decennial Census (US Census, 2010) and American Community Survey (ACS) 5-year (2011-2015) (ACS, 2016)

Figure 3-7: Environmental Justice Populations in the Socioeconomic Resources ICE Study Area



Table 3-5 presents the median household income of residents in the study Census block groups and if any of these block groups meet the definition of a low-income population. According to the 2015 HHS poverty guidelines, the poverty threshold for a four-person family is \$24,250. No study Census block groups have median household incomes below this threshold, and therefore, none are considered low-income populations. However, the Spring Garden Apartments at 7995 Richmond Highway in the northern Study Area has federally assisted affordable housing considered a low-income population for the purposes of this study.

Economics

Census data was collected for the following geographic areas within the Socioeconomic Resources ICE Study Area: income and employment data (ACS 5-year 2011-2015) by Census block group; industry employment data by Census tract (ACS 5-year 2011-2015), and 2014 business patterns by zip code (County Business Patterns, 2015).

Income

Table 3-5 summarizes the American Community Survey (ACS) 5-year 2011-2015 median household income data of persons residing in the study Census block groups. Census block group 4215.00 BG 3 located in Hybla Valley had the lowest median household income (\$25,957) and block group 4159.00 BG 2 located in Mount Vernon had the highest median household income (\$154,408). The median household income of all of the study Census block groups is \$67,163, which is less than that of Fairfax County (\$112,552), but greater than that of Virginia (\$65,015).

Employment

The study Census block groups' labor force and employment data (ACS 5-year 2011-2015) are summarized and compared to Fairfax County and Virginia data in **Table 3-6**. According to the ACS data, approximately 93.1 percent of the work force in the study Census block groups is employed. This is less than the Fairfax County (95.2 percent) employment rate and similar to the statewide rate (93.7 percent).

Table 3-6: Study Census Block Group Employment Characteristics

Geographic Areas / Block Groups	Total Population	Total Population in Labor Force	Total Employed (Civilian and Military)	Total Employed Percent
4154.02 BG 3	728	450	439	97.6%
4155.00 BG 4	812	564	547	97.0%
4159.00 BG 2	1,719	1,142	1,099	96.2%
4160.00 BG 1	1,207	949	900	94.8%
4160.00 BG 2	2,523	1,756	1,718	97.8%
4161.00 BG 1	2,197	1,310	1,274	97.3%
4215.00 BG 2	1,836	1,199	1,046	87.2%
4215.00 BG 3	1,072	820	805	98.2%
4216.00 BG 2	1,637	1,211	1,078	89.0%
4216.00 BG 3	929	763	745	97.6%
4217.01 BG 1	2,671	2,213	2,017	91.1%
4217.01 BG 2	1,143	795	724	91.1%
4218.00 BG 1	1,321	1,015	934	92.0%

Geographic Areas / Block Groups	Total Population	Total Population in Labor Force	Total Employed (Civilian and Military)	Total Employed Percent
4218.00 BG 2	2,928	2,389	2,197	92.0%
4218.00 BG 3	887	676	543	80.3%
Study Block Groups Total	23,610	17,252	16,066	93.1%
Fairfax County	886,641	645,715	614,777	95.2%
Virginia	6,598,956	4,376,786	4,100,756	93.7%

Source: ACS 5-year (2011-2015) (ACS, 2016)

Between 2006 and 2015, unemployment in Fairfax County and Virginia was approximately 3.0 percent or less (Bureau of Labor Statistics, 2016). At the height of the recession in 2010, Fairfax County had an unemployment rate of approximately 5.0 percent while statewide unemployment peaked at 7.0 percent. The unemployment rate has been decreasing since 2010 (Bureau of Labor Statistics, 2016). In 2015, unemployment in Fairfax County was approximately 3.5 percent while Virginia was 4.5 percent. The majority of civilian workers residing in the study Census tracts are engaged in professional, scientific, management, administrative, and waste management (17.7 percent); and educational services, health care, and social assistance (16.6 percent) industry sectors. In comparison, the same categories account for 24.8 percent and 17.7 percent of respective employed residents in Fairfax County, and 14.7 percent and 21.8 percent in Virginia.

Business

The US Census Bureau's Business Patterns 2014 data provides certain business characteristics by NAICS code and zip code. **Figure 3-8** displays the boundaries for zip codes 22306 and 22309 that encompass the Study Area. As shown in **Table 3-7**, 519 business establishments are in zip code 22306 and 390 in zip code 22309 (US Census, 2016b). The top five establishment sectors in the Socioeconomic Resources ICE Study Area zip codes are: retail trade (15.7 percent); health care and social assistance (14.0 percent); other services (13.4 percent); professional, scientific, and technical services (11.2 percent); and accommodation and food services (11.0 percent).

The majority of establishments in zip code 22306 have one to four employees (48.7 percent) with the largest establishment having 1,000 employees or more. Within zip code 22309, the majority of establishments also have one to four employees (63.6 percent) and the largest establishment has 100 to 249 employees (**Table 3-7**). Overall, the Socioeconomic Resources ICE Study Area zip codes have 909 establishments of which 55.1 percent have one to four employees. The majority of Fairfax County establishments have one to four employees as well (55.5 percent). In addition, 49 establishments (0.2 percent) in the county have more than 1,000 employees. Statewide, over half (52.7 percent) of establishments have one to four employees and 182 establishments (0.1 percent) have more than 1,000 employees.

Figure 3-8: Study Area Zip Code Boundaries



Table 3-7: Number of Establishments by North American Industry Classification System (NAICS) Code for Study Zip Codes

Establishment Size	Zip Code	Zip Code	Study Zip Code Total	
	22306	22309		
Establishments with 1 to 4 employees	253	248	501	55.1%
Establishments with 5 to 9 employees	91	61	152	16.7%
Establishments with 10 to 19 employees	94	52	146	16.1%
Establishments with 20 to 49 employees	47	24	71	7.8%
Establishments with 50 to 99 employees	22	4	26	2.9%
Establishments with 100 to 249 employees	7	1	8	0.9%
Establishments with 250 to 499 employees	4	0	4	0.4%
Establishments with 500 to 999 employees	0	0	0	0.0%
Establishments with 1,000 employees or more	1	0	1	0.1%
Total Establishments	519	390	909	
Annual Payroll (\$million)	\$315.8	\$87.9	\$403.7	

Source: US Census Bureau Zip Code Business Patterns by Employment Size (US Census, 2016b)

Land Use and Locality Plans

Information on land use was gathered from local comprehensive and land use plans, aerial photos, input from local and regional planning officials, and field reconnaissance. As shown in **Table 3-8** and **Figure 3-9**, the land use within the Socioeconomic Resources ICE Study Area is primarily commercial followed by residential; recreation and open space; institutional, government, and utilities; and industrial. There is no agricultural land use within the Socioeconomic Resources ICE Study Area.

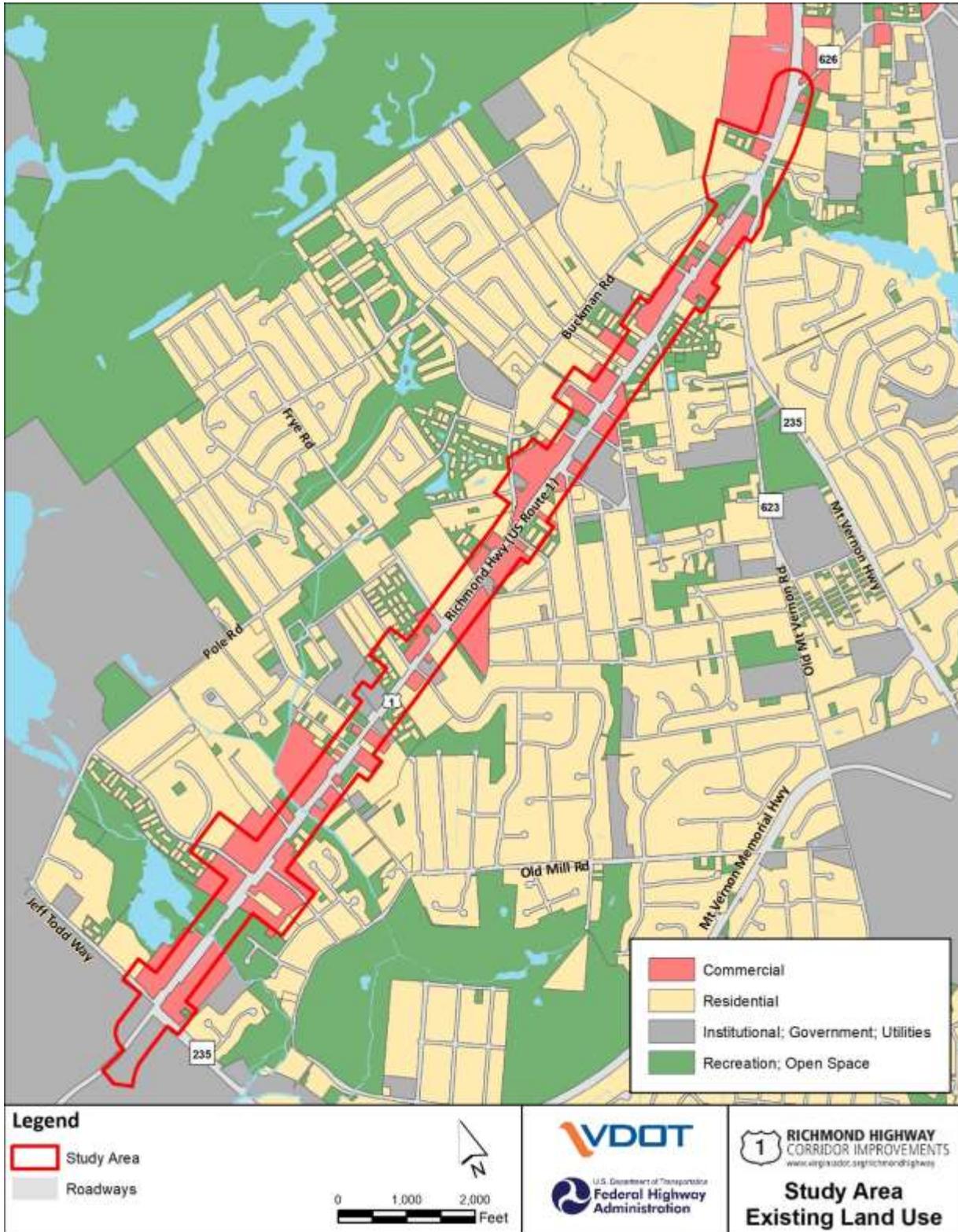
Table 3-8: Socioeconomic Resources ICE Study Area Existing Land Use

Land Use	Acres	Percent of Study Area Land Use
Agricultural	0.0	0.0%
Commercial	183.0	47.0%
Residential	102.0	26.2%
Industrial	0.0	0.0%
Institutional, Government, Utilities	41.5	10.7%
Recreation and Open Space	62.7	16.1%
Total	389.2	

Source: Fairfax County GIS (Fairfax County, 2016b)

As discussed in **Section 3.2.2**, the Socioeconomic ICE Study Area is within the Mount Vernon Planning District (**Figure 3-4**). The Mount Vernon Planning District’s vision for future development is to “achieve the highest quality of life possible through expanding economic opportunity, access to quality education and public services, and through achieving balance between transportation and residential, commercial, and industrial growth” (Fairfax County, 2013a). As stated in the Plan, transportation objectives in the Richmond Highway Corridor include providing improved traffic circulation and traffic safety during both peak and non-peak hours, while minimizing right-of-way impacts to adjacent residential communities.

Figure 3-9: Socioeconomic Resources ICE Study Area Existing (2016) Land Use



The *Fairfax County Comprehensive Plan* (2013) also makes land use recommendations based on identified Community Business Centers (CBC) and Suburban Neighborhoods. Three CBCs, including Hybla Valley/Gum Springs, South County Center, and Woodlawn, and three Suburban Neighborhoods are within the Socioeconomic Resources ICE Study Area (**Figure 3-10**). Development recommendations for the CBCs and Suburban Neighborhoods are intended to foster revitalization, redevelopment, and creation of distinctive urban environments (Fairfax County, 2013a).

Fairfax County is currently considering changes to the Comprehensive Plan that would foster transit-oriented development near anticipated future stations along Richmond Highway (Fairfax County, 2016c). The county is evaluating Plan changes that would specify new planned land use density and the mix of land uses, as well as street grids conducive to transit-oriented development, among other things.

3.3.2 Natural Resources

Waters, Wetlands, and Water Quality

The Natural Resources ICE Study Area includes portions of two 12-digit HUCs, covering an area of more than 21,000 acres. The eastern portion of the Natural Resources ICE Study Area is in the Potomac River – Little Hunting Creek subwatershed (HUC 020700100307) and the western portion of the Natural Resources ICE Study Area is located in the Dogue Creek subwatershed (HUC 020700100306) (**Figure 3-11**). All waters within the Natural Resources ICE Study Area ultimately flow to the Potomac River.

The Natural Resources ICE Study Area contains a large number of named and unnamed perennial and intermittent streams. National Hydrography Dataset (NHD) estimates there to be approximately 311,240 linear feet of streams and an additional 1,647 acres of waterbodies within the Natural Resources ICE Study Area. Of these, Dogue Creek, Little Hunting Creek, and the Potomac River are the most prominent and longest stream courses.

Many surface waters in the Natural Resources ICE Study Area fail to meet state water quality standards and are designated as “impaired waters” under Section 303(d) of the CWA. There are three impaired stream segments located within the Natural Resources ICE Study Area, totaling approximately 31,102 linear feet (VDEQ, 2014). Causes of impairment to these streams include polychlorinated biphenyl (PCB) in water column (one segment), benthic macroinvertebrate bioassessments (one segment), *E. coli* (two segments), and low levels of dissolved oxygen (one segment). The major suspected sources of the impairments include atmospheric deposition of toxics, combined sewer overflow, contaminated sediments, upstream sources, and unknown sources (**Figure 3-12** and **Table 3-9**).

Figure 3-10: Community Business Centers within the Socioeconomic Resources ICE Study Area



Figure 3-11: NHD Streams within the Natural Resources ICE Study Area

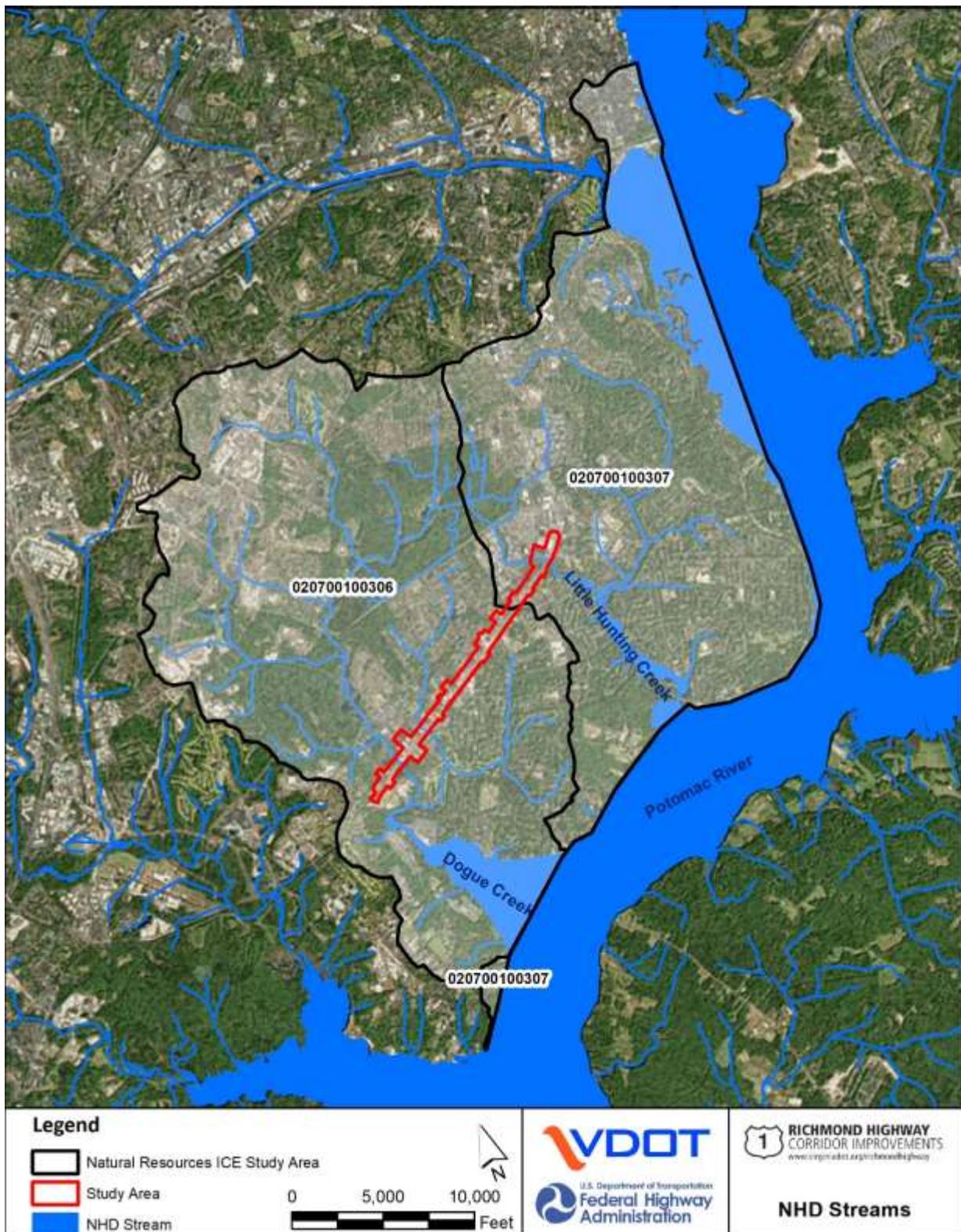


Figure 3-12: Impaired Stream and Estuarine Segments within the Natural Resources ICE Study Area

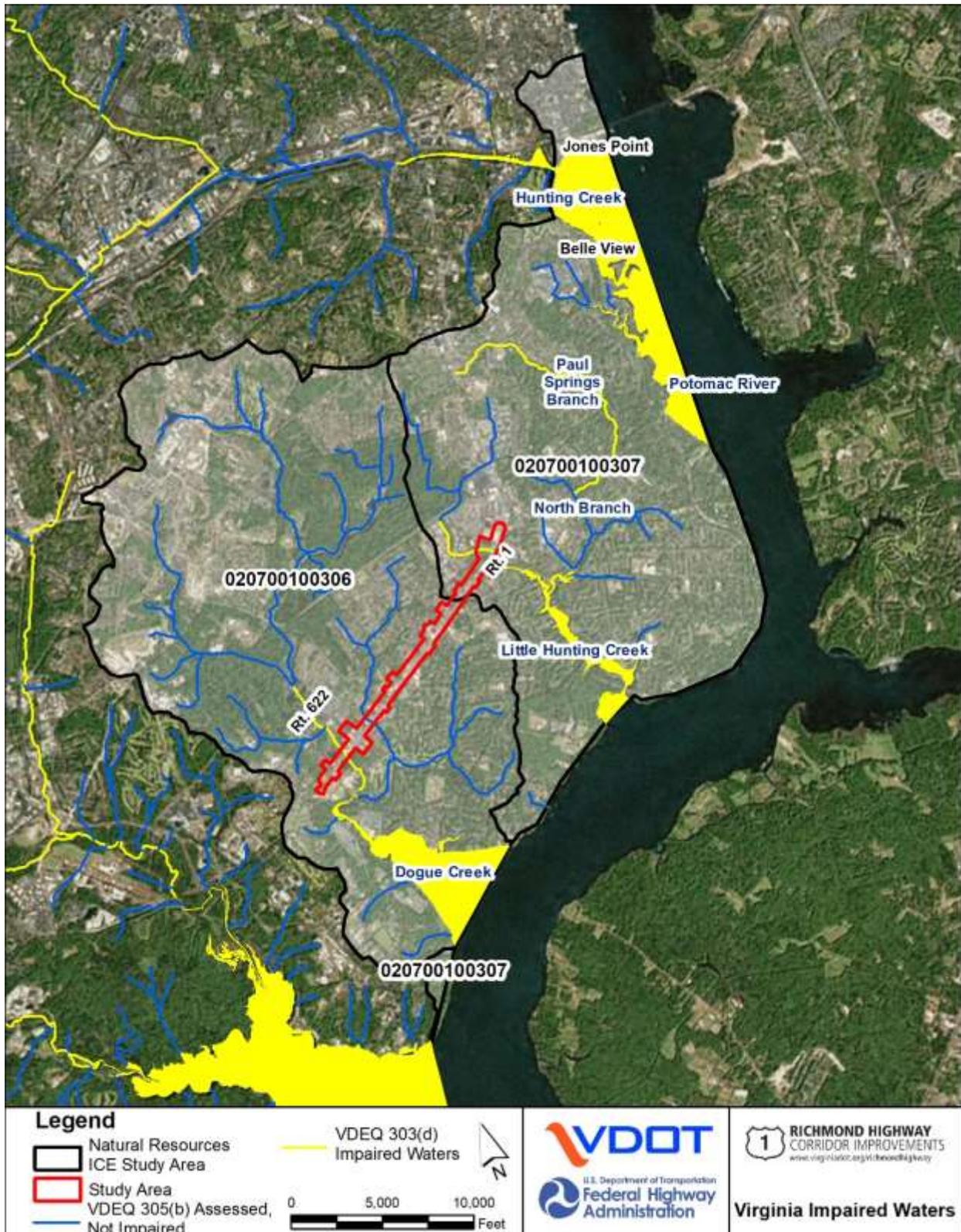


Table 3-9: Impaired Stream Segments within the Natural Resources ICE Study Area

ID	Waters Name	Impairment Reach	Impairment Cause	Impairment Source	Impairment Length within Study Area
VAN-A14R_ LIF01A08	Little Hunting Creek	Segment begins at the confluence with an unnamed tributary, approximately 0.82 rivermiles upstream from the Route 1 bridge, and continues downstream until tidal waters	PCB in Water Column	Atmospheric Deposition – Toxics, Combined Sewer Overflows, Contaminated Sediments, Upstream Source	5,772.6 ft
VAN-A14R_ PAU01A04	Paul Springs Branch	Segment begins at the headwaters of Paul Spring Branch and continues downstream to confluence with North Branch	Benthic-Macroinvertebrate Bioassessments, E. coli, Dissolved Oxygen	Source Unknown	17,879.3 ft
VAN-A14R_ DOU01A04	Dogue Creek	Segment begins at the confluence with an unnamed tributary to Dogue Creek, approximately 0.3 rivermiles upstream from Rt. 622, and continues downstream until the end of the free-flowing waters of Dogue Creek	E.coli	Source Unknown	7,449.9 ft

Source: Final 2014 VDEQ 305(b)/303(d) Integrated Report (VDEQ, 2014)

Additionally, there are approximately 1,457 acres of impaired estuarine waters within the Natural Resources ICE Study Area, consisting of four segments. These impaired estuarine waters, which make up all of the estuarine waters in the Natural Resources ICE Study Area, are impaired due to E. coli (one segment), low dissolved oxygen (four segments), PCB in fish tissue (four segments), and PCB in the water column (one segment). The major suspected sources of the impairments include atmospheric deposition of nitrogen and toxics, combined sewer overflow, contaminated sediments, industrial point source discharge, internal nutrient cycling, loss of riparian habitat, municipal point source discharges, sanitary sewer overflows (collection system failures), and wet weather discharges (non-point source) (**Figure 3-12** and **Table 3-10**) (VDEQ, 2014).

Table 3-10: Impaired Estuarine Segments within the Natural Resources ICE Study Area

ID	Waters Name	Impairment Reach	Impairment Cause	Impairment Source	Impairment Acreage within Study Area
VAN-A13E_ HUT01A02	Hunting Creek	Segment includes all tidal waters of Hunting Creek; beginning outside of the Natural Resources ICE Study Area and continuing downstream until the mouth of the embayment, at Jones Point and Belle View	E. coli, Dissolved Oxygen, PCB in Fish Tissue, PCB in Water Column	Atmospheric Deposition – Nitrogen and Toxics, Combined Sewer Overflows, Contaminated Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Sanitary Sewer	287.9 ac
VAN-A14E_ DOU01A00	Dogue Creek	Segment includes all tidal waters of Dogue Creek, extending from approximately rivermile 2.1 until the confluence with the Potomac River	Dissolved Oxygen, PCB in Fish Tissue	Atmospheric Deposition – Nitrogen and Toxics, Combined Sewer Overflows, Contaminated Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges	470.5 ac
VAN-A14E_ LIF01A00	Little Hunting Creek	Segment includes all tidal waters of Little Hunting Creek, extending from approximately rivermile 1.7 downstream until the confluence with the Potomac River	Dissolved Oxygen, PCB in Fish Tissue	Discharges, Wet Weather Discharges	159.1 ac
VAN-A14E_ POT01A08	Potomac River	Segment includes all tidal waters downstream of the mouth of the Hunting Creek embayment, at Jones Point and Belle View	Dissolved Oxygen, PCB in Fish Tissue		540.0 ac

Source: Final 2014 VDEQ 305(b)/303(d) Integrated Report (VDEQ, 2014)

The National Wetlands Inventory (NWI) depicts 2,893 acres of wetlands in the Natural Resources ICE Study Area (USFWS, 2016). Of these, approximately 1,303 acres (45%) are vegetated wetlands (emergent, scrub-shrub, and forested) and approximately 1,590 acres (55%) are classified as open water (including freshwater ponds, lakes, and riverine open waters) (**Figure 3-13**). These wetlands and waters are interspersed within the industrial, commercial, and residential areas, and are mostly remnants of larger ecosystems within the floodplains. In general, the subwatersheds are highly urbanized and many of the wetlands and waters have been historically impacted by impervious and semi-impervious surfaces that either abut or are located in close proximity to the existing wetlands and waters.

Floodplains

The Federal Emergency Management Agency’s (FEMA) Flood Insurance Rate Maps (FIRM) were used to estimate the acreage of floodplains within the Natural Resources ICE Study Area. Approximately 3,568 acres of 100-year floodplains and 217 acres of 500-year floodplains exist within the Natural Resources ICE Study Area (**Figure 3-14**). No FEMA regulated floodways are located within the Natural Resources ICE Study Area.

Wildlife Habitat

The Natural Resources ICE Study Area contains a mixture of land cover including, but not limited to, developed land, farmland, and forest (**Figure 3-15**). The composition of land cover directly affects the natural communities, wildlife, and biodiversity found within the Natural Resources ICE Study Area. **Table 3-11** shows the acreage and percentage of each land cover within the Natural Resources ICE Study Area.

Table 3-11: Land Cover within the Natural Resources ICE Study Area

Land Cover	Acres within Natural Resources ICE Study Area	Percent of Natural Resources ICE Study Area
Developed	12,285	58%
Forest	4,689	22%
Agriculture	190	<1%
Barren Land	86	<1%
Scrub/Shrub/Grasslands	259	1%
Wetlands (including open water)	3,819	18%
Total	21,328	100%

Source: NOAA Coastal Change Analysis Program (C-CAP), (NOAA, 2010)

The wildlife in the Natural Resources ICE Study Area primarily consists of species that are adapted to urbanized environments; however, some of the major riparian corridors contain forested habitat that supports fauna more typically found within less disturbed floodplain forests, including neotropical migrant birds. These riparian corridors with native vegetation can serve as wildlife corridors, linking wildlife habitats that might otherwise be separated by human development (NWF, 2016).

Wildlife corridors within the Natural Resources ICE Study Area were identified using aerial imagery. Streams with contiguous forest cover generally greater than 0.25 mile in width were selected as wildlife corridors, and include portions of Dogue Creek, Little Hunting Creek, Barnyard Run, Piney Run, Paul Springs Branch, and the Potomac River. These corridors are intersected by roads, which fragment the corridor, but do not prevent the continued use of corridors.

Figure 3-13: NWI Wetlands within the Natural Resources ICE Study Area

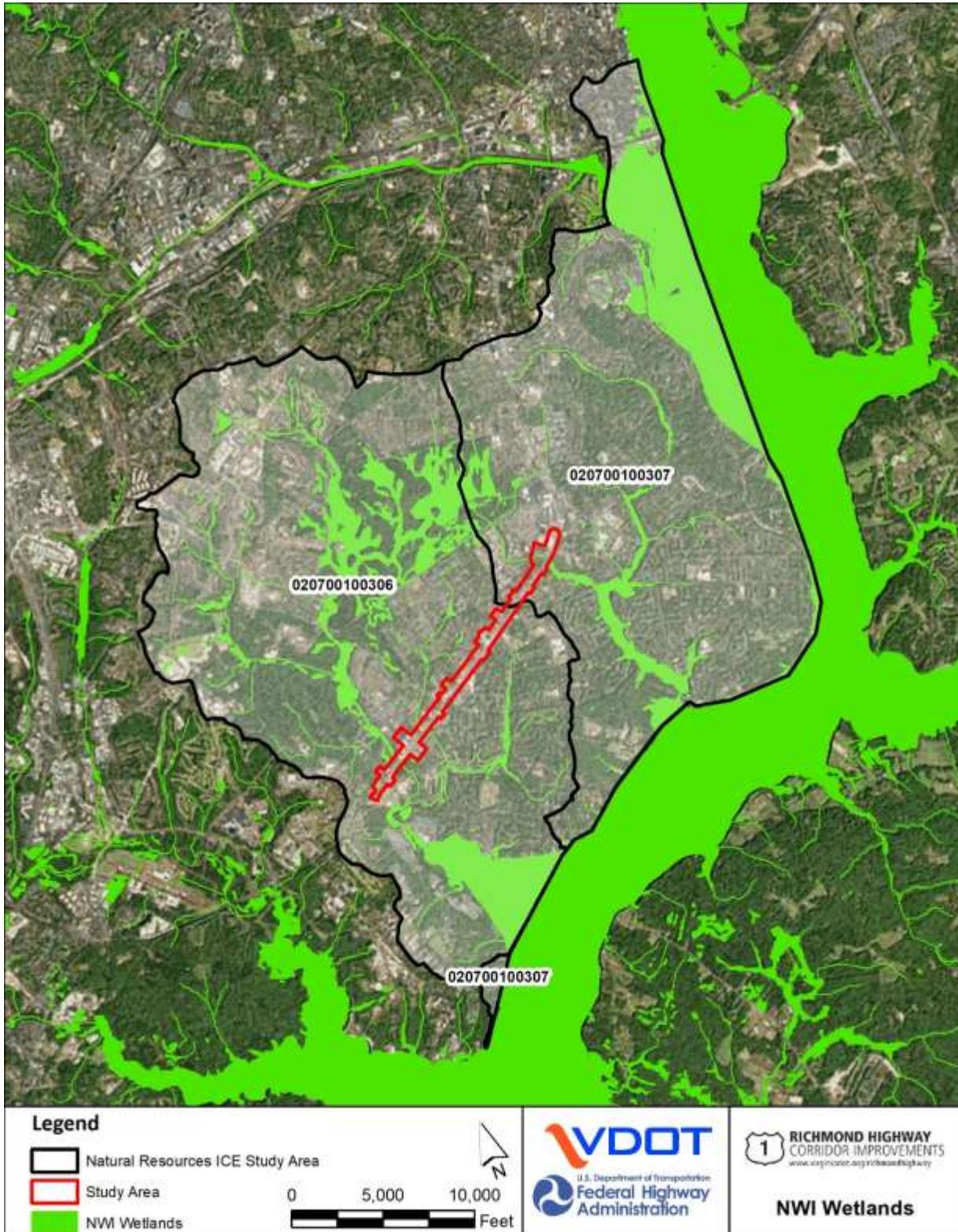


Figure 3-14: FEMA Floodplains within the Natural Resources ICE Study Area

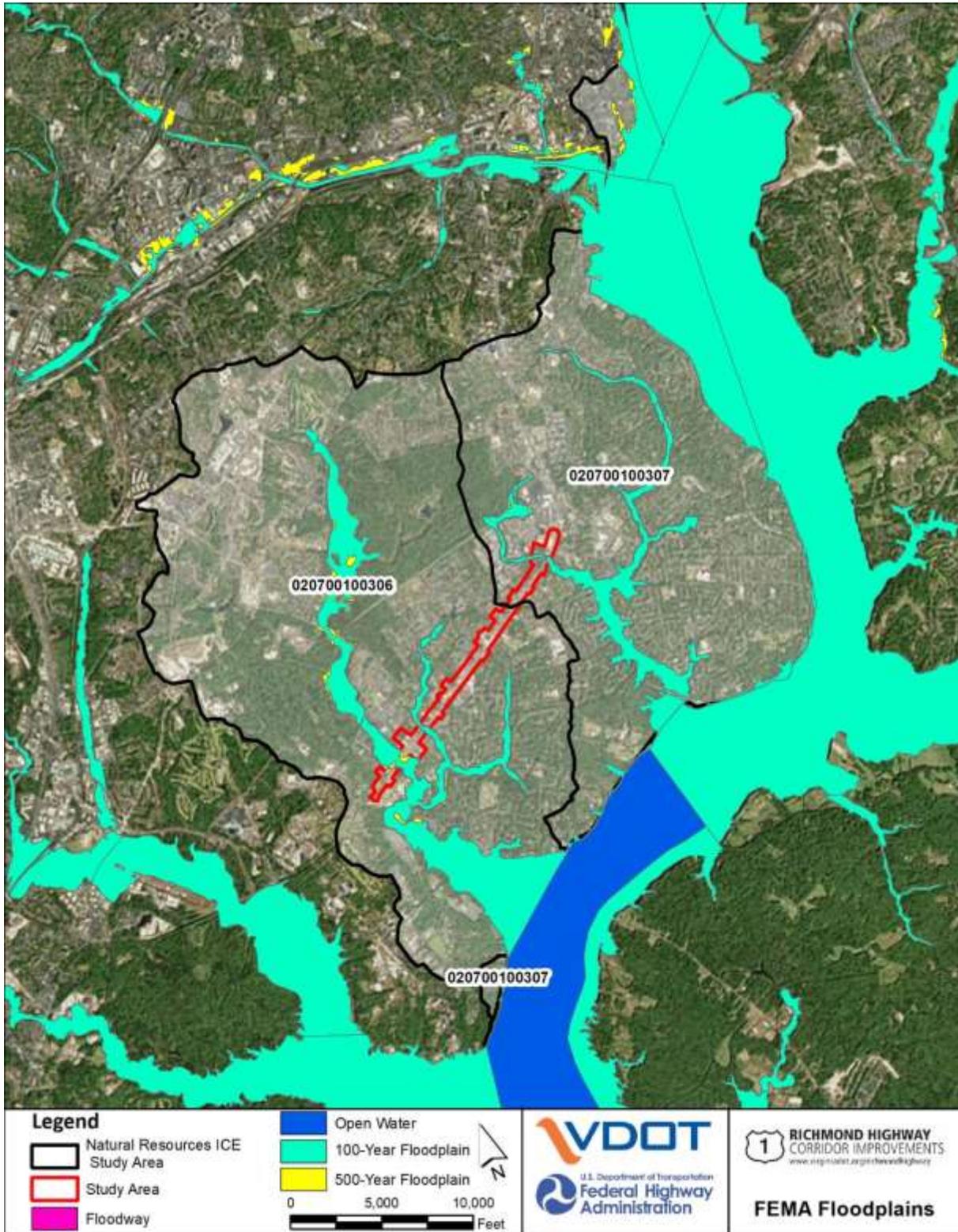
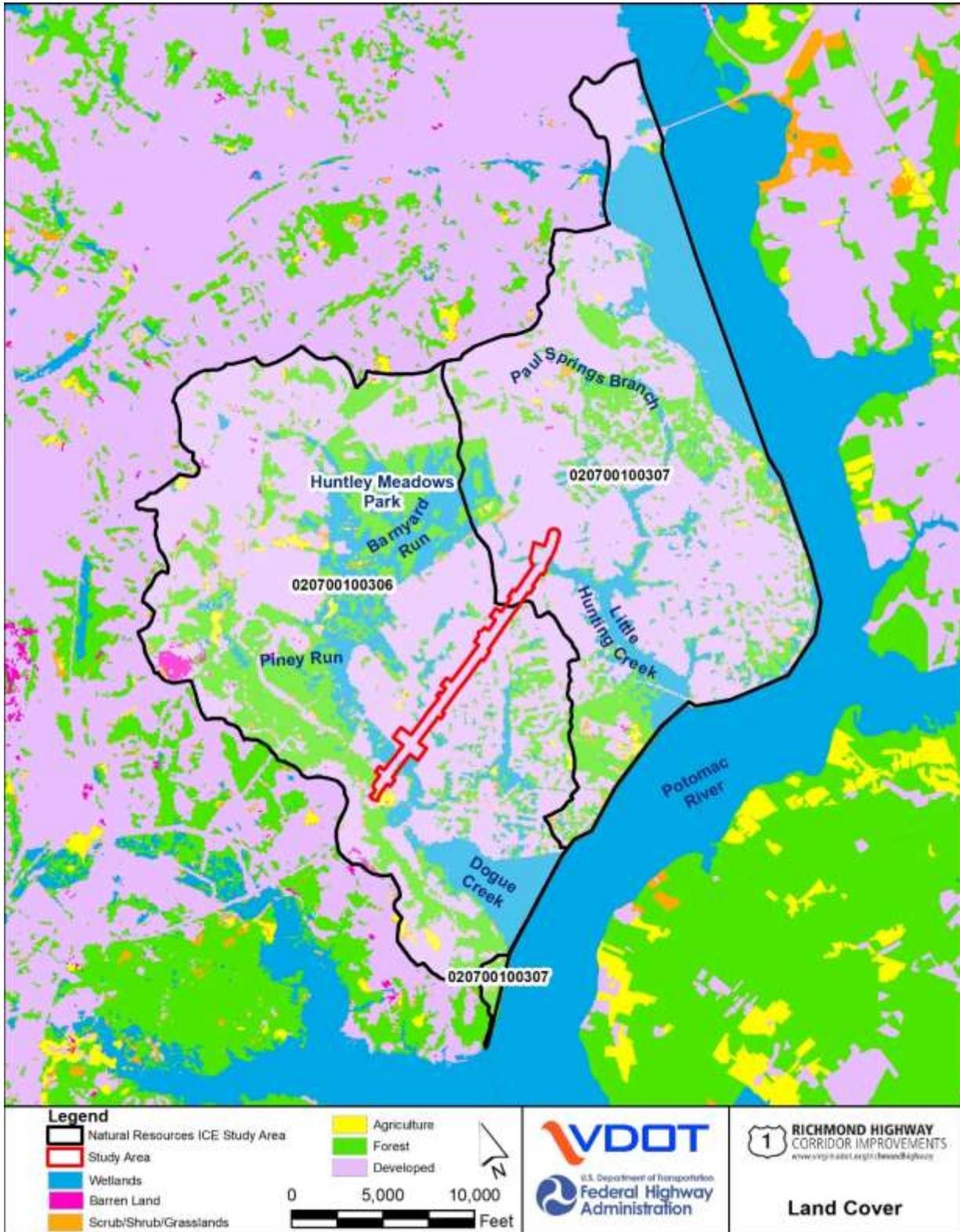


Figure 3-15: Land Cover within the Natural Resources ICE Study Area



Additionally, Huntley Meadows Park, the largest park operated by the Fairfax County Park Authority (1,557 acres), lies within the Natural Resources ICE Study Area, providing wildlife corridors and core areas for a variety of species. The wetlands and forests of this park provide natural habitat adjacent to an otherwise developed Northern Virginia (Fairfax County, 2017).

Fairfax County, which makes up the majority of the Natural Resources ICE Study Area, maintains a list of wildlife found within the area (Fairfax County, 2016g).

Common mammal species include:

- Coyote (*Canis latrans*)
- Beaver (*Castor canadensis*)
- Opossum (*Didelphis virginiana*)
- Big brown bat (*Eptesicus fuscus*)
- Silver-haired bat (*Lasionycteris noctivagans*)
- Eastern red bat (*Lasiurus borealis*)
- Hoary bat (*Lasiurus cinereus*)
- Bobcat (*Lynx rufus rufus*)
- Groundhog (*Marmota monax*)
- Striped skunk (*Mephitis mephitis*)
- Little brown bat (*Myotis lucifungus*)
- White-tailed deer (*Odocoileus virginianus*)
- Eastern pipistrelle (*Perimyotis subflavus*)
- Raccoon (*Procyon lotor*)
- Gray squirrel (*Sciurus carolinensis pennsylvanicus*)
- Fox squirrel (*Sciurus niger vulpinus*)
- Fisher's easter chipmunk (*Tamias striatus fisheri*)
- Gray fox (*Urocyon cinereoargenteus*)
- Black bear (*Ursus americanus*)
- Red fox (*Vulpes vulpes*)

Common amphibian and reptile species include:

- Eastern cricket frog (*Acris crepitans*)
- Northern copperhead (*Agkistrodon contortrix mokasen*)
- Spotted salamander (*Ambystoma maculatum*)
- Marbled salamander (*Ambystoma opacum*)
- American toad (*Anaxyrus americanus*)
- Fowler's toad (*Anaxyrus fowleri*)
- Eastern wormsneak (*Carphophis amoenus amoenus*)
- Northern scarletsnake (*Cemophora coccinea copei*)
- Northern black racer (*Coluber constrictor constrictor*)
- Timber rattlesnake (*Crotalus horridus*)
- Northern dusky salamander (*Desmognathus fuscus*)
- Northern ringneck snake (*Diadophis punctatus edwardsii*)
- Northern two-lined salamander (*Eurycea bislineata*)
- Three-lined salamander (*Eurycea guttolineata*)
- Four-toed salamander (*Hemidactylium scutatum*)
- Eastern hognose snake (*Heterodon platirhinos*)
- Cope's gray treefrog (*Hyla chrysoscelis*)
- American green tree frog (*Hyla cinerea*)
- Mole kingsnake (*Lampropeltis calligaster*)
- Eastern kingsnake (*Lampropeltis getula*)

- Eastern milksnake (*Lampropeltis triangulum*)
- American bullfrog (*Lithobates catesbeianus*)
- Northern green frog (*Lithobates clamitans*)
- Pickerel frog (*Lithobates palustris*)
- Southern leopard frog (*Lithobates sphenoccephalus*)
- Wood frog (*Lithobates sylvaticus*)
- Northern watersnake (*Nerodia sipedon*)
- Red-spotted newt (*Notophthalmus viridescens*)
- Northern rough greensnake (*Opheodryx aestivus*)
- Eastern ratsnake (*Pantherophis alleghaniensis*)
- Red cornsnake (*Pantherophis guttatus*)
- Northern red-backed salamander (*Plethodon cinereus*)
- White-spotted slimy salamander (*Plethodon cylindraceus*)
- Northern spring peeper (*Pseudacris crucifer*)
- Eastern mud salamander (*Pseudotriton montanus montanus*)
- Northern red salamander (*Pseudotriton ruber ruber*)
- Upland chorus frog (*Pseudacris feriarum*)
- Queen snake (*Regina septemvittata*)
- Eastern spadefoot (*Scaphoopus holbrookii*)
- Northern brownsnake (*Storeria dekayi dekayi*)
- Northern red-bellied snake (*Storeria occipitomaculata*)
- Common ribbon snake (*Thamnophis sauritus*)
- Eastern garter snake (*Thamnophis sirtalis*)
- Eastern smooth earthsnake (*Virginia valeriae*)

Common bird species include:

- Cooper's hawk (*Accipiter cooperii*)
- Sharp-shinned hawk (*Accipiter striatus*)
- Canada geese (*Branta canadensis*)
- Northern cardinal (*Cardinalis cardinalis*)
- American goldfinch (*Carduelis tristis*)
- House finch (*Carpodacus mexicanus*)
- Turkey vulture (*Cathartes aura*)
- Rock pigeon (*Columba livia*)
- Black vulture (*Coragyps atratus*)
- American crow (*Corvus brachyrhynchos*)
- Fish crow (*Corvus ossifragus*)
- Bluejay (*Cyanocitta cristata*)
- Bald eagle (*Haliaeetus leucocephalus*)
- Red-bellied woodpecker (*Melanerpes carolinus*)
- Northern mockingbird (*Mimus polyglottos*)
- Carolina chickadee (*Parus carolinensis*)
- House sparrow (*Passer domesticus*)
- Carolina wren (*Thryothorus ludivicanus*)
- House wren (*Troglodytes troglodytes*)
- American robin (*Turdus migratorius*)

Common fish species include:

- White catfish (*Ameiurus catus*)
- Yellow bullhead (*Ameiurus natalis*)
- Brown bullhead (*Ameiurus nebulosus*)
- American eel (*Anguilla rostrata*)
- Central stoneroller (*Campostoma anomalum*)
- Goldfish (*Carassius auratus*)
- White sucker (*Catostomus commersoni*)
- Northern snakehead (*Channa argus*)
- Rosyside dace (*Clinostomus funduloides*)
- Potomac sculpin (*Cottus girardi*)
- Satinfish shiner (*Cyprinella* spp.)
- Common carp (*Cyprinus carpio*)
- Gizzard shad (*Dorosoma cepedianum*)
- Bluespotted sunfish (*Enneacanthus gloriosus*)
- Creek chubsucker (*Erimyzon oblongus*)
- Greenside darter (*Etheostoma blennioides*)
- Tessellated darter (*Etheostoma olmstedii*)
- Cutlips minnow (*Exoglossum maxillingua*)
- Banded killifish (*Fundulus diaphanous*)
- Mummichog (*Fundulus heteroclitus*)
- Eastern mosquitofish (*Gambusia holbrooki*)
- Eastern silvery minor (*Hybognathus regius*)
- Northern Hogsucker (*Hypentelium nigricans*)
- Channel catfish (*Ictalurus punctatus*)
- Least brook lamprey (*Lampetra aepyptera*)
- Redbreast sunfish (*Lepomis gibbosus*)
- Green sunfish (*Lepomis cyanellus*)
- Bluegill (*Lepomis macrochirus*)
- Common shiner (*Luxilus cornutus*)
- Redear sunfish (*Mepomis microlophus*)
- White perch (*Morone americana*)
- Smallmouth bass (*Micropterus dolomieu*)
- Largemouth bass (*Micropterus salmoides*)
- Golden redhorse (*Moxostoma erythrurum*)
- River chub (*Nocomis mircopogon*)
- Golden shiner (*Notemigonus crysoleucas*)
- Comely shiner (*Notropis amoenus*)
- Silverjaw minnow (*Notropis buccatus*)
- Spottail shiner (*Notropis hudsonius*)
- Swallowtail shiner (*Notropis procne*)
- Margined madtom (*Noturus insignis*)
- Yellow perch (*Perca flavescens*)
- Stripeback darter (*Percina notogramma*)
- Shield darter (*Percina peltata*)
- Bluntnose minnow (*Pimephales notatus*)
- Fathead minnow (*Pimephales promelas*)
- Black crappie (*Pomoxis nigromaculatus*)
- Blacknose dace (*Rhinichthys atratulus*)
- Longnose dace (*Rhinichthys cataractae*)
- Creek chub (*Semotilus atromaculatus*)
- Fatfish (*Semotilus corporalis*)
- Eastern mudminnow (*Umbra pygmaea*)

Threatened, Endangered, and Special Status Species

US Fish and Wildlife Service’s (USFWS) Information for Planning and Conservation (IPaC), the Virginia Department of Game and Inland Fisheries (VDGIF) Fish and Wildlife Information Service (VaFWIS), the VDGIF Wildlife Environmental Review Map Service (WERMS), and the Virginia Department of Conservation and Recreation Division of Natural Heritage (VDCR-DNH) databases were queried on February 28, 2017, to identify documented threatened, endangered, or special status species within the Natural Resources ICE Study Area, as well as those species that have potential habitat in the Natural Resources ICE Study Area. All species identified in the database searches were carried forward for further analysis, with the exception of those identified in the VAFWIS database. According to the VDGIF Interagency Coordination Recommendations, only species confirmed on the VAFWIS database should be carried forward for further analysis. All species carried forward for further analysis are depicted in **Table 3-12**.

Table 3-12: Threatened, Endangered, and Special Status Species within the Natural Resources ICE Study Area

Common Name	Scientific Name	Legal Status	IPaC	VDCR-DNH (12-Digit HUC)	VaFWIS (2 Mile Buffer)	WERMS
Northern long-eared bat	<i>Myotis septentrionalis</i>	FT, ST	X			
Bald eagle	<i>Haliaeetus leucocephalus</i>	Protected Under the Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act, and Lacey Act				X
Peregrine falcon	<i>Falco peregrinus</i>	ST			C	
Wood turtle	<i>Glyptemys insculpta</i>	ST		X	C	
Tri-colored bat	<i>Perimyotis subflavus</i>	SE			C	

FE = federally endangered, FT= federally threatened, SE = state endangered, ST = state threatened, C=confirmed occurrence
Source: USFWS IPaC (USFWS, 2017b), VDGIF-VaFWIS (VDGIF, 2017a, Virginia Natural Heritage Database Search (VDCR-DNH, 2017), and WERMS (VDGIF, 2017b)

Two streams in the Natural Resources ICE Study Area, Dogue Creek and an unnamed tributary to Dogue Creek, have been designated as threatened and endangered waters for the wood turtle. These threatened and endangered waters total approximately 23,934 linear feet. Two streams, Dogue Creek and the Potomac River, have been confirmed as Anadromous Fish Use Streams. Both streams have documented occurrences of alewife, blueback herring, striped bass, and yellow perch; the Potomac River also has documented occurrences of hickory shad and American shad. These confirmed Anadromous Fish Use Streams total approximately 1,383 acres.

The following is a description of each of the identified threatened, endangered, and special status species potentially located within the Natural Resources ICE Study Area.

Northern Long-Eared Bat

Home range for the northern long-eared bat is widely but patchily distributed in the eastern and north-central United States and adjacent southern Canada, and southward to southern Texas, Louisiana, Alabama, Georgia, and Florida, and westward in the United States generally to the eastern margin of the Great Plains region (NatureServe, 2017). In the winter, they hibernate in caves, mines, and tunnels with relatively constant and cool temperatures, high humidity, and no air currents. In the summer, they roost in old-growth forests with uneven forest structure, single and multiple tree-fall gaps, standing snags, and woody debris. Major threats to the species existence include the fungal disease white-nose syndrome (WNS), wind energy development, and habitat modification. This species has not been recorded within the Natural Resources ICE Study Area, but IPaC has predicted potential occurrences. VDGIF's northern long-eared bat winter habitat and roost trees mapper indicates the closest known hibernacula or roost tree is over 90 miles away from the Natural Resources ICE Study Area (VDGIF, 2017c).

Bald Eagle

The bald eagle is a wide-ranging species found throughout much of North America (NatureServe, 2017). Most eagles that breed in Canada and the northern US move south for winter. Bald eagles migrate widely over most of North America. In the northern Chesapeake Bay region, radio-tagged northern migrants arrive in late fall and depart in early spring; radio-tagged southern migrants arrive throughout April-August and depart June-October. Winter home ranges can be very large, especially for nonbreeding birds.

Breeding habitat most commonly includes areas close to (within 2.5 miles) coastal areas, bays, rivers, lakes, reservoirs, or other bodies of water that reflect the general availability of primary food sources including fish, waterfowl, or seabirds. Nests usually are in tall trees, on pinnacles, or cliffs near water. Tree species used for nesting vary regionally and may include pine, spruce, fir, cottonwood, poplar, willow, sycamore, oak, beech, or others. The same nest may be used year after year, or a pair may use alternate nest sites in successive years.

In winter, bald eagles may associate with waterfowl concentrations or congregate in areas with abundant dead fish or other food resources. Wintering areas are commonly associated with open water though in the region some bald eagles use habitats with little or no open water if upland food resources (e.g. rabbit or deer carrion, livestock afterbirths) are readily available. Wintering eagles tend to avoid areas with high levels of nearby human activity (boat traffic, pedestrians) and development (buildings). Bald eagles preferentially roost in conifers or other sheltered sites in winter in some areas; typically the birds select the larger, more accessible trees. Communal nesting sites used by two or more eagles are common. Winter nesting sites vary in their proximity to food resources (up to 20 miles) and may be determined to some extent by a preference for a warmer microclimate at these sites. Available data indicate that energy conservation may or may not be an important factor in winter nest-site selection.

Bald eagle sightings have been recorded within the Natural Resources ICE Study Area. Additionally, the Center for Conservation Biology (CCB) mapping portal depicts bald eagle nests within the Natural Resources ICE Study Area (CCB, 2017).

Peregrine Falcon

The peregrine falcon breeds on every continent except Antarctica. In North America, much recovery of populations has occurred (NatureServe, 2017). The peregrine falcon prefers various open habitats from tundra, moorlands, steppe, and seacoasts, especially where there are suitable nesting cliffs, to mountains, open forested regions, and human population centers. When not breeding, the species occurs in areas

where prey concentrate, including farmlands, marshes, lakeshores, river mouths, tidal flats, dunes and beaches, broad river valleys, cities, and airports.

Peregrines often nest on a ledge or hole on the face of rocky cliff or crag. River banks, tundra mounds, open bogs, large stick nests of other species, tree hollows, and man-made structures (e.g., ledges of city buildings) are used locally. Man-made sites, including tall buildings, bridges, rock quarries, and raised platforms, are frequently the nest sites of choice in Virginia. The peregrine falcon has been confirmed within a two mile buffer of the Natural Resources ICE Study Area.

Wood Turtle

The wood turtle is a small turtle that is found throughout much of the east coast and midwest from northern Virginia to Nova Scotia and eastern Minnesota to the northern Appalachians. Suitable habitat consists of forested floodplains, fields, wet meadows, and farmland as long as these places have a large creek or stream nearby. They prefer slow moving waters and often hibernate under submerged logs, in beaver dams, or in muskrat burrows. They wander around on land in the summer and hibernate in deep pools during the winter. Threats include destruction of habitat, vehicular encounters, and pet trade (Harding, 2017). Wood turtle has been confirmed within a two mile buffer of the Natural Resources ICE Study Area.

Tri-Colored Bat

The tri-colored bat range is throughout eastern United States and Canada (NatureServe, 2017). The tri-colored bat is associated with forested landscapes, where the species forages near trees (including forest perimeters) and along waterways. In many areas, most foraging occurs in riparian areas. Maternity and other summer roosts are mainly in dead or live tree foliage (including attached lichen clumps such as *Usnea* and "Spanish moss"); caves, mines, and rock crevices may be used as night roosts between foraging forays. Maternity colonies also utilize human-made structures (buildings, bridges), or tree cavities; sometimes the maternity colonies are in open sites that would not be tolerated by most other bats. Reproductive females roost alone or in groups of up to about 50 individuals. Hibernation sites often are in caves, mines, or cavelike tunnels, as well as box culverts under highways, especially those near forest. Hibernating individuals perch singly, infrequently in small groups. This species has been confirmed within a two-mile buffer of the Natural Resources ICE Study Area. VDGIF's tri-colored and little brown bat habitat mapper indicates the closest hibernacula is over 100 miles away from the Natural Resources ICE Study Area. There are no recorded roost trees in Virginia (VDGIF, 2017c).

3.3.3 Historic Resources

Historic resources are considered notable features for their value to the area's historical and cultural foundations, and the state and nation's heritage. The National Historic Preservation Act (NHPA) [16 U.S.C. §470] defines a historic property as any "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP), including artifacts, records, and material remains related to such a property or resource." For the purpose of this analysis, historic resources are archaeological sites and architectural resources eligible for listing or listed in the NRHP.

Four architectural resources are either eligible for, potentially eligible for, or listed on the NRHP (**Table 3-13** and **Figure 3-16**). One of these resources, Woodlawn Plantation (029-0056), is also a designated National Historic Landmark. No archaeological sites were found to be eligible for the NRHP.

Figure 3-16: Historic Resources within the Historic Resources ICE Study Area

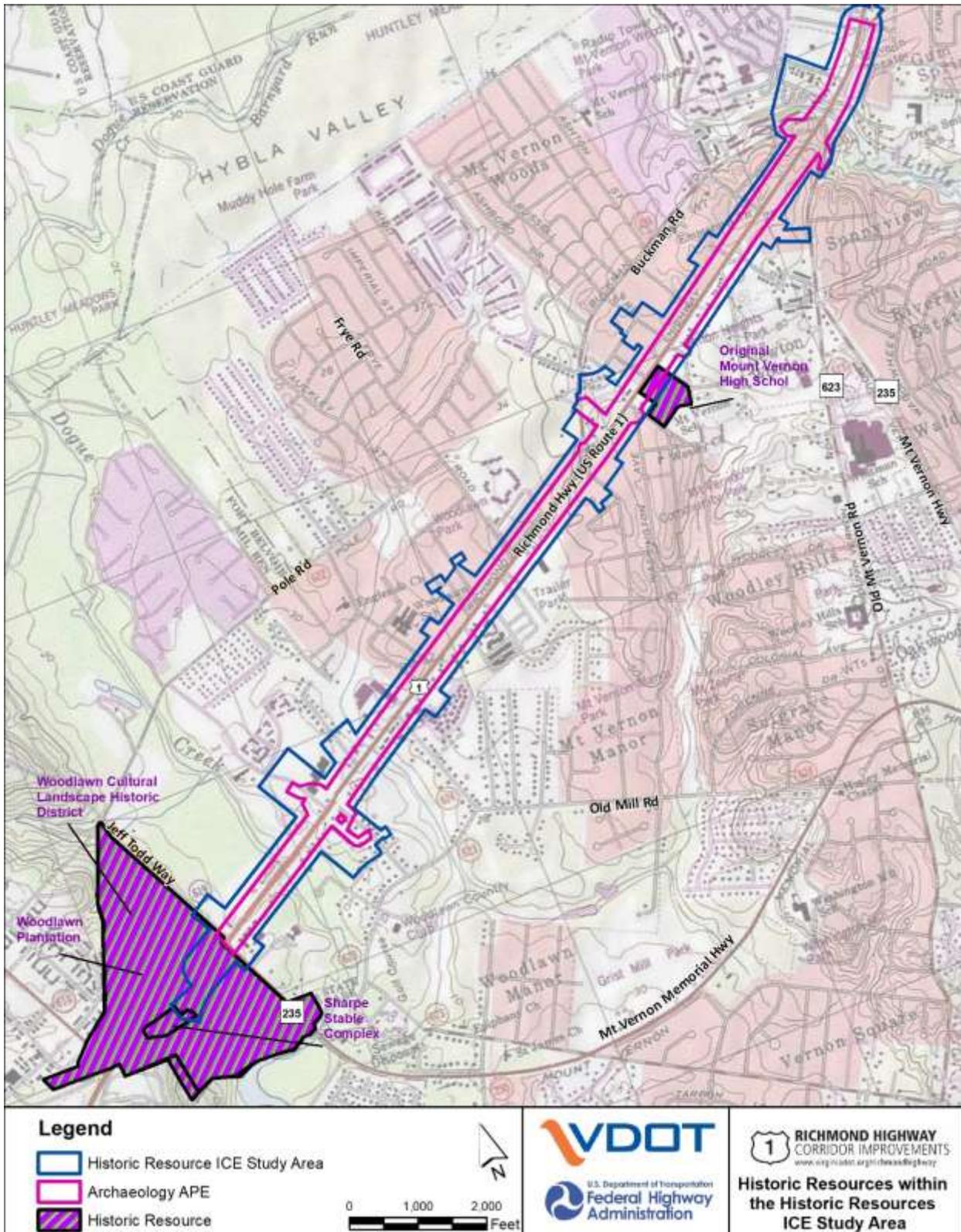


Table 3-13: Historic Resources within the Historic Resources ICE Study Area

Resource	Virginia Department of Historic Resources (VDHR) Number	Description	NRHP Eligibility
Woodlawn Plantation	029-0056	Ca. 1800 plantation	National Historic Landmark, NRHP Listed, Contributory to Woodlawn Cultural Landscape District
Original Mount Vernon High School (OMVHS)	029-0230	1939 Colonial Revival Former High School	NRHP Listed
Woodlawn Cultural Landscape Historic District	029-5181	Rural cultural landscape associated with Woodlawn Plantation and George Washington's Mount Vernon (1799-1964)	Potentially Eligible
Sharpe Stable Complex	029-5181-0005	Ca. 1913-1997 bank barn, riding rink, and paddocks	Individually Potentially Eligible, Contributory to Woodlawn Cultural Landscape District

3.4 STEP 4: IDENTIFY IMPACT CAUSING ACTIVITIES OF THE BUILD ALTERNATIVE

The objective of this step is to identify direct impacts that could have indirect effects that may conflict with the regional direction and goals discussed in **Step 2** and/or impact the resources identified in **Step 3**. The NCHRP Report 466 includes groups of actions associated with transportation projects that are known to trigger indirect effects. Some examples of these impact-causing activities include alteration of drainage, channelization, noise and vibration, cut and fill, barriers, excavation, erosion and sediment control, landscaping, and alteration of travel time/cost. The estimated direct impacts due to impact-causing activities are summarized in **Table 3-14**. These impacts are conservative and are based upon the study area, not the construction limits. Comparing impact causing activities to regional directions and goals and the resources in the ICE Study Areas enables the identification of resources that could be indirectly affected. The findings of this identification process are presented in **Step 5**.

Table 3-14: Direct Impacts of the Alternatives

Notable Feature	No-Build Alternative	Build Alternative
Community		
Potential parcel relocations (No. Residential / Commercial)	0	7 / 44
Community Facilities		
Portions of Right-of-Way Acquisitions (No. Parcels)	0	7
Relocations (No. Parcels)	0	2 Religious Institutions
Bike Paths and Recreational Trails		
Bike Paths	0	Short-term impacts & long-term benefits

Notable Feature	No-Build Alternative	Build Alternative
Population and Housing Characteristics		
Population and Housing	0	No substantial impacts
Environmental Justice		
Displacements in EJ Census block groups:		
• Housing Units/Affected Parcels Minority Populations	0	15 / 6
• Housing Units/Affected Parcels Low-Income Population	0	24 / 1
Economics		
Economics	0	Short-term beneficial impacts & no long-term impacts
Land Use		
Permanent Right-of-Way Acquisition (acres)	0	22
Waters, Wetlands, and Water Quality		
Stream Impacts (Linear Feet)	0	963.2
Wetlands (Acres)	0	0.2
Land Disturbance (Acres)	0	76.6
Floodplains		
100 Year Floodplains (Acres)	0	8.6
Wildlife Habitat, Threatened, Endangered, and Special Status Species		
Threatened, Endangered, and Special Status Species or potential habitat (No.)	0	6
Anadromous Fish (No.)	0	0
Historic Resources		
Historic Resources Properties (No.)	0	1

3.5 STEP 5: IDENTIFY INDIRECT EFFECTS FOR ANALYSIS

The objective of this step is to assess whether direct impacts identified above would have the potential to indirectly effect the identified resources. As discussed in **Section 2.2**, indirect effects can occur in the following three broad categories:

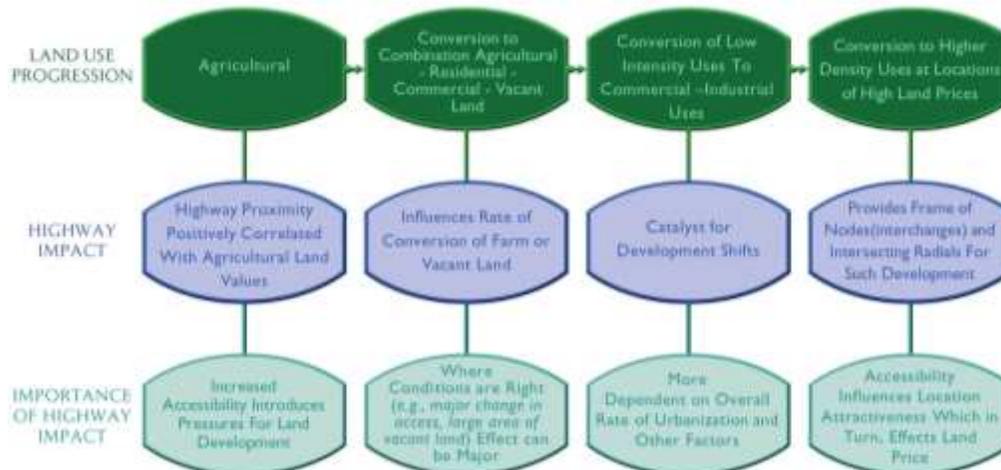
- **Encroachment-Alteration Impacts** – Alteration of the behavior and functioning of the affected environment caused by project encroachment (physical, biological, socioeconomics) on the environment;
- **Induced Growth Impacts** – Project-influenced development effects (land use); and
- **Impacts Related to Induced Growth** – Effects related to project-influenced development effects (impacts of the change of land use on the human and natural environment).

Development of vacant land or conversion of the built environment to more intensive uses are often consequences of highway projects. The NCDOT *Guidance for Assessing Indirect and Cumulative Impacts of Transportation Projects in North Carolina, Vol. II: Practitioners Handbook* provides characteristics for induced growth as well as illustrates the different stages of development (see **Figure 3-17**) (NCDOT, 2001).

These characteristics include existing land use conditions in the project area, increased accessibility that may result from new transportation improvements, local political and economic conditions, the availability of other infrastructure, and the rate of urbanization in the region. The ICE Study Areas are already highly developed and built-out with mature infrastructure. Review of aerial photography shows that more than 90 percent of the area within 1 mile of the direct effects Study Area is developed or undevelopable (see Appendix B for details).

The No-Build Alternative does not consist of any alterations to the existing roadway other than reasonably foreseeable planned projects. The potential human and environmental impacts of future BRT along Richmond Highway through the Study Area will be analyzed in a separate NEPA document. The Build Alternative would be on existing alignment and would not create any new interchanges or intersections. The Build Alternative would provide a median wide enough to accommodate BRT as called for in the DRPT Multimodal Study / Fairfax County Board of Supervisors Resolution. The median would be maintained as a grass strip until the implementation of the BRT. Although induced growth is not anticipated under either alternative, under the No-Build Alternative, land use changes could occur in the future based on Fairfax County Plans¹. These land use changes could also occur under the Build Alternative; however the Build Alternative is not anticipated to indirectly impact growth. The discussion below provides a summary of potential indirect effects meriting analysis, identifying the indirect effect type, the impact-causing activities (direct effects), indirect effects from direct effects, and a description of the potential change.

Figure 3-17: Highway Investment on Typical Progress of Urbanization



3.5.1 Socioeconomic Resources

Communities

The No-Build Alternative would include increased routine maintenance and repairs of existing transportation infrastructure and have no direct physical impact on communities; however, without transportation improvements, travel congestion and lack of vehicular and pedestrian and bicycle access could negatively impact community connectivity and cohesion.

¹ Fairfax County is currently developing a Proposed Plan Amendment as part of the Embark Richmond Highway initiative. Information is available at <http://www.fairfaxcounty.gov/dpz/embarkrichmondhwy>.

Possible impacts of the Build Alternative consist of potentially 40 displaced housing units on six residential parcels, 38 displaced commercial buildings on 42 parcels, one acquisition of an undeveloped commercial parcel, and displacing two community facilities on two parcels, mainly distributed in the Woodlawn and Mount Vernon communities. Widening Richmond Highway would marginally increase the separation distance between communities located on either side of the road. The indirect impacts may include minor alterations in community cohesion due to displacements and changes in community access. During construction, short-term road closures, detours and loss of parking would indirectly affect communities by potentially increasing commute times, emergency vehicle response times, and limiting or restricting access to neighborhoods, community facilities, or businesses. Because indirect effects are possible, communities have been advanced to **Step 6** in this analysis.

Community Facilities

The No-Build Alternative would have no direct impact on community facilities; however, increased traffic delays, congestion, and lack of roadway vehicle, bicycle, and pedestrian travel mobility and reliability could reduce access to community facilities throughout the Socioeconomic Resources ICE Study Area.

The Build Alternative has the potential to directly and indirectly impact community facilities within the Socioeconomic Resources ICE Study Area. Potential impacts include two community facility displacements, First AME Church and Spirit of Faith Ministries in the Mount Vernon Community, due to the proximity of proposed right-of-way acquisition. Additionally, portions of proposed right-of-way would be acquired from seven community facility parcels. Proposed access management has the potential to indirectly affect the function of community facilities by closing and re-routing access to parcels. Short-term construction could cause noise impacts and temporary road closures and detours, which during construction, could increase travel time to community facilities.

The Build Alternative's indirect impacts may include making some community facilities or services more accessible, while other places may require modification in their route for access. The Build Alternative could have a positive indirect effect on community facilities resulting from decreased congestion that improves travel time and reliability and potential increased community facility use in the Socioeconomic Resources ICE Study Area. The improved bicycle and pedestrian access along the corridor could also have a positive indirect effect, as people walking and bicycling may increase their usage of community facilities. During construction, short-term road closures and detours could indirectly increase the time to access community facilities. Because indirect effects are possible, community facilities have been advanced to **Step 6** in this analysis.

Bike Paths and Recreational Trails

The No-Build Alternative would not result in improvements to Richmond Highway in the Study Area, nor would it result in changes to existing bike routes. Increased traffic congestion could have a negative effect on Study Area bike routes safety.

The Build Alternative would provide enhanced bicycle and pedestrian facilities to both sides of Richmond Highway, contributing to an increase in safety and connectivity to existing regional bicycle and pedestrian networks. There are no recreational trails located in the Socioeconomic Resources ICE Study Area. Short-term impacts to existing pedestrian facilities and bike routes along Richmond Highway during construction could include detours and temporary closures. The Build Alternative's indirect impacts may include changes in community connectivity, such as an increase in utilization of bicycle and pedestrian travel networks and increased bicycle and pedestrian choice in mode of transportation between communities

and neighborhoods. Indirect impacts may also include a reduced rate of bicycle/pedestrian and motor vehicle crashes and/or desire for additional bicycle and pedestrian network connectivity. Because indirect effects are possible, bike paths and recreational trails have been advanced to **Step 6** in this analysis.

Population and Housing Characteristics

The No-Build Alternative would not result in project-related construction or any associated property acquisitions. Therefore, no direct or indirect impacts to population or housing would result from the No-Build Alternative.

The Build Alternative would potentially require 40 housing unit displacements on six residential parcels adjacent to the existing Richmond Highway right-of-way; however, the number may be reduced in advanced design. Relocation assistance in accordance with all applicable regulations would be provided. Since the properties are located on the edge of the communities adjacent to Richmond Highway, and the vacancy rate is such that the residences should be able to relocate within the area, minor impacts are anticipated to population and housing. Because indirect effects would be minor, population and housing characteristics are not advanced to **Step 6** in this analysis.

Environmental Justice

The No-Build Alternative would not result in improvements to Richmond Highway. Any potential indirect effects, such as potential traffic delays and congestion on Richmond Highway, would be borne by all populations; therefore, no disproportionate indirect impacts on low-income or minority populations residing in the Socioeconomic ICE Study Area are anticipated.

The Build Alternative would reduce congestion, improve corridor accessibility and mobility, and enhance pedestrian and bicycle facilities. These improvements would be borne equally by all who reside along the Richmond Highway corridor, including Census block groups that contain minority populations. A low-income population is identified at the Spring Garden Apartment complex in the northern Study Area. Although residential relocations would occur within some areas designated as minority populations, it is not known at this time whether affected individuals would be minorities. While 15 housing units on six residential parcels may be displaced within Census block groups containing minority populations, the range of non-minority residents within those block groups is between 15.9 and 84.1 percent, increasing the probability that relocations would not result in disproportionate impacts. Up to 24 housing units where a low-income population resides at the Spring Garden Apartment complex may be displaced under the Build Alternative, but other apartment and single-family housing would be similarly impacted in areas not meeting the definition of a low-income population; thus, the impact to low-income populations would not be disproportionate. Because indirect effects would not likely be disproportionate, EJ has not been advanced to **Step 6** in this analysis.

Economics

The No-Build Alternative would not make any improvements to Richmond Highway in the Study Area, and thus no direct or indirect impacts to income, employment, or economics would occur.

The Build Alternative would potentially require 38 commercial building displacements on 42 parcels and total acquisition of one undeveloped commercial lot; however, the number may be reduced in advanced design. Commercial relocations would not impact median household income within the Socioeconomic Resources ICE Study Area, employment, or more than approximately four percent of the total

establishments within the zip codes encompassing the Socioeconomic Resources ICE Study Area (**Figure 3-8**). Additionally, relocation assistance in accordance with all applicable regulations would be provided.

During construction, short-term road closures, detours and loss of parking would indirectly affect businesses and the local economy by potentially increasing commute times and limiting or restricting access to businesses. Displacements of residences and business would occur under the Build Alternative that could expose properties that were previously set back from Richmond Highway to be closer to the improved roadway. Indirect effects to economics could occur as a result of some of these property owners choosing to move rather than be closer to the highway. Additional indirect effects could include potential benefits from increased access and travel reliability for customers and deliveries, including potential increased visitation to local businesses. Because indirect effects would be possible, economics has been advanced to **Step 6** in this analysis.

Land Use and Locality Plans

The No-Build Alternative is not anticipated to have any direct impact on land use; therefore, no indirect impacts to land use or locality plans would occur.

The Build Alternative has potential to directly impact land use immediately adjacent to Richmond Highway, including permanent and temporary right-of-way acquisitions, such as a 22-acre permanent land use conversion to transportation use. However, the conversion to transportation use would be relatively small when compared to the existing total acreage per land use class in the Socioeconomic Resources ICE Study Area and consistent with local land use plans, and would therefore not cause indirect effects. Therefore, land use and locality plans has not been advanced to **Step 6** in this analysis.

3.5.2 Natural Resources

Waters, Wetlands, and Water Quality

The No-Build Alternative is not anticipated to have any direct impacts to waters, wetlands, and water quality. However, continued indirect effects to water quality would be expected due to petroleum spills and leaks from vehicles and chemical runoff from road maintenance activities.

The Build Alternative has the potential to directly impact waters and wetlands due to widening or lengthening existing road crossings and drainage structures. Potential indirect effects resulting from project construction include potential changes to impaired waters and total maximum daily loads [TMDLs] from increased runoff, changes in hydrologic regime, changes in light regime, and introduction of invasive species. However, implementation of the Build Alternative could potentially improve water quality due to the installation of new stormwater facilities. Because indirect effects would be possible, waters, wetlands, and water quality have been advanced to **Step 6**.

Floodplains

The No-Build Alternative would not include any improvements to Richmond Highway, and therefore is not anticipated to have any direct or indirect impacts to floodplains.

The Build Alternative could result in direct impacts to floodplains from widening or lengthening road crossings across floodplains. If fill is placed in floodplains, flood storage capacity could be affected, potentially resulting in alteration of drainage patterns, water quality degradation, changes in flood flow elevations, and associated effects on floral and faunal communities. Because indirect effects on floodplains would be possible, this resource is advanced to **Step 6**.

Wildlife Habitat

The No-Build Alternative would not include any improvements to Richmond Highway, and therefore is not anticipated to have any direct impacts to wildlife habitat from not implementing the Build Alternative.

The Build Alternative could cause direct impacts through loss of wildlife habitat associated with widening the roadway, potentially leading to indirect effects such as changes in regime (e.g. light, hydrology) and changes in vegetation composition. Additionally, increased traffic along the widened roadway could have indirect effects to wildlife and wildlife habitat, including increased noise, trash, potential for animal-vehicle collisions, and potential for oil spills. Construction activities could also have the indirect effect of introducing invasive species that may have traveled to the area on equipment and vehicles traveling from other locations. Given the potential for indirect effects under the Build Alternative, wildlife habitat is included in **Step 6** of this analysis.

Threatened, Endangered, and Special Status Species

The No-Build Alternative would not include any improvements to Richmond Highway, and therefore is not anticipated to have any direct impacts to threatened, endangered, or special status species

The Build Alternative is not anticipated to directly impact threatened, endangered, or special status species. However, construction of the Build Alternative may indirectly affect threatened, endangered, and special status species by altering landscape or stream habitat. Such alterations may include increased noise, changes in landcover/habitat, increased potential for animal-vehicle collisions, altered hydrology and degradation of water quality. Given the potential for indirect effects, this resource is advanced to **Step 6**.

3.5.3 Historic Resources

The No-Build Alternative would not include any improvements to Richmond Highway, and therefore is not anticipated to have any direct impacts to historic resources from not implementing the Build Alternative. However, without the improvements, traffic congestion in the area would continue to increase, affecting the access to the historic resources.

The Build Alternative would directly impact the Original Mount Vernon High School (OMVHS) designated VDHR # 029-0230. The NRHP boundary of the school property is anticipated to be truncated by approximately 50 to 60 feet along the property's frontage with Richmond Highway. This area currently is the location of a circular entrance driveway and parking area that appears to have been constructed sometime during 1951-1953. Comparison of historic aerials indicate the circular driveway has had several modifications from its original appearance. Also, the original purpose of the circular driveway as a school bus drop off location has been eliminated with the closing of the county school in the mid-1980s. These events indicate the physical integrity of the historic setting and feeling of the circular driveway feature has been previously diminished and no longer conveys its historic significance.

Woodlawn Plantation (029-0056), the Woodlawn Cultural Landscape Historic District (029-5181) and the Sharpe Stable Complex (029-5181-0005) are situated south of the southern terminus of the Build Alternative, but the proposed improvements are within the viewshed of these historic properties. Although a change in views from portions of these historic properties toward the southern terminus of the project would occur, this change would not diminish any aspects of integrity as existing conditions have previously diminished the historic setting and feeling of this area due to a major intersection upgrade, including previous widening of Jeff Todd Way and the Mount Vernon Memorial Highway (VA

235) in 2013 to 2014, and recent widening and partial realignment of Richmond Highway south of Jeff Todd Way.

VDOT coordinated with VDHR regarding all direct, indirect, and cumulative impacts related to historic properties in the study area. Because direct and indirect effects are anticipated under the Build Alternative, historic resources are advanced to **Step 6**.

3.6 STEP 6: ANALYZE INDIRECT EFFECTS AND EVALUATE ANALYSIS RESULTS FOR THE NO-BUILD AND BUILD ALTERNATIVE

Using planning judgment, this step analyzes indirect and induced growth effects potentially resulting from each alternative under consideration.

3.6.1 No-Build Alternative

Effects to Socioeconomic Resources

Under the No-Build Alternative, increased traffic delays and congestion would have an adverse indirect effect on community facilities, businesses and residents throughout the Socioeconomic Resources ICE Study Area. The lack of improved bicycle and pedestrian access could also have an adverse indirect effect on socioeconomic resources throughout the Socioeconomic Resources ICE Study Area. Additional proximity effects such as noise, air quality, and visual intrusions are expected as a result of the increased traffic congestion along the existing roadway network.

Effects to Natural Resources

Under the No-Build Alternative, there would be no improvements to Richmond Highway other than routine maintenance. Potential indirect effects could be associated with petroleum spills and leaks from vehicles, salt or chemicals due to maintenance activities, and animal-vehicle collisions.

Effects to Historic Resources

No loss or damage to historic resources is anticipated under the No-Build Alternative. Increased traffic delays would negatively affect the accessibility to the identified historic resources.

Induced Growth

No induced growth would be expected as a result of the No-Build Alternative. The ICE Study Areas and surrounding locality is already highly developed and built-out with mature infrastructure.

Effects Related to Induced Growth

Since no induced growth would be expected as a result of the No-Build Alternative, there would likely be no effects related to the lack of induced growth.

3.6.2 Build Alternative

Effects to Socioeconomic Resources

The Build Alternative involves improvements to an existing facility with bicycle and pedestrian accommodations and would require additional right-of-way in some locations for construction of the proposed improvements adjacent to the existing Richmond Highway right-of-way in the Study Area.

Community

Based on conceptual design, potential right-of-way acquisition would include a 22-acre permanent land use conversion to transportation use. This would result in two community facilities, displacement of 38 commercial buildings on 42 parcels, total acquisition of one undeveloped commercial property, and up to 40 housing unit displacements on six residential parcels. During construction, short-term road closures, detours and loss of parking would indirectly affect communities by potentially increasing commute times, emergency vehicle response times, and limiting or restricting access to neighborhoods or community facilities. Widening Richmond Highway would marginally increase the separation distance between communities located on either side, because the relationship between the roadway and adjoining communities has been established and all local road crossings would be maintained, indirect effects to community cohesion would be minor. Proposed relocations would be located along the edge of communities adjacent to Richmond Highway, minimizing community indirect effects. During advanced design, right-of-way impacts to adjacent properties have the potential to be reduced.

The Build Alternative's indirect impacts may consist of reduced rate of bicycle/pedestrian and motor vehicle crashes, an increase in bicycle and pedestrian network usage, and a shift in community transportation mode choice from motor vehicle to bicycle and pedestrian passage between communities, residents, neighborhoods and businesses.

Community Facilities

Proposed right-of-way acquisition would lead to two community facility relocations, both religious institutions that are close to the existing Richmond Highway. Additionally, portions of proposed right-of-way would be acquired from seven community facility parcels; however, without affecting their function. Access routes to individual community facility parcels may be closed to improve traffic and safety, however, some parcels have more than one access, and at least one access per parcel would be provided. No adverse effects to the function of these community facilities would therefore occur.

The Build Alternative's indirect impacts may include altering access to community facilities or services, through new travel patterns, reduced travel time, and increased travel reliability in the Study Area. Additionally, since the Build Alternative would improve an existing roadway rather than on new alignment, potential effects to community facilities would be minimized.

Short-term construction could cause temporary noise impacts, temporary road closures, and detours that could cause increased travel time to community facilities. However, since the construction would be of limited duration, the indirect effects would be minor.

Bike Paths and Recreational Trails

The Build Alternative would provide enhanced bicycle and pedestrian facilities to both sides of Richmond Highway; existing bicycle and pedestrian network cohesion and safety would be improved. Short-term impacts to existing pedestrian facilities and bike routes along Richmond Highway during construction could include detours and temporary closures. These effects would be short-term, ending once construction was completed.

New travel patterns would consolidate access points to Richmond Highway and reduce direct access to Richmond Highway, increasing safety for people driving, walking, or bicycling, and reducing congestion and enhancing existing bicycle and pedestrian networks along Richmond Highway. The Build Alternative's indirect impacts may consist of reduced rate of bicycle/pedestrian and motor vehicle crashes, an increase in bicycle and pedestrian network utilization, and a change in community transportation mode choice

from motor vehicle to bicycle and pedestrian passage between communities, residents, neighborhoods and businesses. Collectively, this could change community connectivity in the study area. The change in transportation choice and enhanced safety and reliability along bicycle and pedestrian networks could impact the desire for increased new bicycle and pedestrian facilities and additional enhanced network connectivity.

Economics

The Build Alternative would potentially require displacing 38 commercial buildings on 42 parcels and total acquisition of one undeveloped commercial lot; however, the number may be reduced in advanced design. The relocations would not impact median household income within the Socioeconomic Resources ICE Study Area or employment. Additionally, only approximately four percent of the total establishments would be impacted, which is a small portion of the total businesses and services within the Study Area zip codes. Improvements to the existing Richmond Highway are anticipated to improve travel time and reliability in the Socioeconomic Resources ICE Study Area which would indirectly benefit businesses and commuters. The increased travel reliability for delivery of and access to goods and services could result in gained economic productivity.

During construction, short-term road closures, detours, and loss of parking would indirectly affect residents, businesses, and the local economy by potentially increasing commute times and limiting or restricting access to businesses. Conversely, in the short-term, hiring for construction could increase local employment and the money spent by workers could benefit local businesses. These effects would be short-term, ending once construction was completed.

Effects to Natural Resources

Waters, Wetlands, and Water Quality

Construction of the Build Alternative may potentially result in short and long-term minor adverse degradation of water quality through increased sedimentation from land disturbing activities, increased runoff from an increase in impervious surface, and occurrences of fuel spills or hydraulic spills from construction equipment. The introduction of pollutants from roadway runoff can facilitate the degradation of nearby terrestrial and aquatic habitat through increased deposition of sediments or contamination from chemical pollutants in the form of heavy metals, inorganic salts, asbestos, and petroleum products and their byproducts. When runoff enters waters that are already impaired, the impacts are cumulative and can result in accelerated changes in the microbenthic community structure and composition, which in turn can affect the fish and amphibian populations that rely on them as a food source, as well as the birds and aquatic mammals that prey on the fish and amphibians. The proposed new stormwater management facilities would help to mitigate these potential effects to water quality by addressing water quality and quantity, and possibly improving water quality over existing conditions.

Construction of the Build Alternative also has the potential to change the hydrologic regime, resulting in long-term minor beneficial and adverse indirect impacts. In most places, Richmond Highway would be widened (including the bridge over Little Hunting Creek) and culverts would be extended, altering the existing hydraulic regime minimally. However, a new, longer bridge is proposed over Dogue Creek, taking the place of the existing short-span bridge. This increased hydraulic opening could increase the hydraulic connectivity of wetlands and streams on both sides of Richmond Highway and would generally improve the geomorphology of Dogue Creek. However, during construction of the bridge, temporary changes may occur in water velocity, depth, and erosion and sedimentation rates, which could impact downstream habitat.

Due to tree removal associated with the Build Alternative, changes in light regime may be expected, resulting in long-term minor adverse impacts. Changes in light regime could alter the vegetation composition of wetlands, which could modify habitat and wildlife composition. Clearing vegetation could allow opportunistic species, including invasive species, to establish. Additionally, the introduction of invasive on construction equipment or vehicles could lead to vegetation, habitat, and wildlife composition changes.

Floodplains

Construction of the Build Alternative could potentially result in long-term minor adverse and beneficial impacts to floodplains. All construction activities would be designed to ensure that culverts and bridges are adequately sized and do not impede floodwater passage. However, if fill is placed into floodplains, the Build Alternative could indirectly alter drainage patterns, increase water quality degradation, change flood flow elevations, and have associated effects on floral and faunal communities. Since the Build Alternative would widen an existing facility, these indirect effects would be minimal compared to existing conditions. However, the proposed replacement of the existing Dogue Creek short-span bridge with a longer and higher bridge could improve floodplain connectivity and alter flood flow elevations.

Wildlife Habitat

Implementation of the Build Alternative could potentially result in short and long-term minor adverse and beneficial impacts to wildlife habitat. Increased noise, human activity, and dust associated with construction could temporarily displace wildlife. Long-term indirect effects to wildlife could include the potential for introduction of invasive species, changes in vegetative composition due to changes in light and hydrologic regimes, and loss of habitat that could displace wildlife. Vegetation, which serves as both a food source and habitat element, could be removed. New stormwater facilities and stormwater regulations would reduce or neutralize impacts to aquatic habitat. Since the Build Alternative would be on an existing alignment, habitat and wildlife corridor fragmentation is not expected to be an indirect effect. Existing culvert and bridge crossings would allow for the continued passage of wildlife beneath Richmond Highway. The proposed replacement of the existing Dogue Creek short span bridge with a longer, higher bridge would allow for continued wildlife movement, aiding aquatic and terrestrial organism passage beneath the road. Wildlife could also experience indirect effects due to increased noise, potential for animal-vehicle collisions, and potential for oil spills. These indirect effects could impact wildlife health and cause species to permanently relocate.

Threatened, Endangered, and Special Status Species

Implementation of the Build Alternative could potentially result in short and long-term minor adverse and beneficial impacts to threatened, endangered, and special status species. Increased noise, human activity, and dust associated with construction could temporarily displace threatened, endangered, and special status species. Long-term indirect effects to threatened, endangered, and special status species could include the introduction of invasive species, changes in vegetative composition due to changes in light and hydrologic regimes, and loss of habitat that could displace wildlife. Vegetation, which serves as both a food source and habitat element, could be removed. New stormwater facilities and stormwater regulations could reduce or neutralize the potential degradation of aquatic habitat. Since the Build Alternative is on existing alignment, habitat fragmentation is not expected to be an indirect effect.

Existing culvert and bridge crossings would allow for the continued passage of threatened, endangered, and special status beneath Richmond Highway. The proposed replacement of the existing Dogue Creek would allow for continued wildlife movement, aiding threatened, endangered, and special status species

passage beneath the road. Consultation with the VDGIF would reduce the potential for indirect adverse effects to up or downstream habitat, if present, that supports the State Threatened wood turtle known to use Dogue Creek in the vicinity of the Richmond Highway crossing. Threatened, endangered, and special status species could also experience indirect effects, if present, due to increased noise, potential for animal-vehicle collisions, and potential for oil spills. These indirect effects could impact the health of threatened, endangered, and special status species, if present, and cause species to permanently relocate.

Effects to Historic Resources

The Build Alternative would affect one historic resource and would indirectly effect two historic resources as well as one historic district. The NRHP boundary of OMVHS (VDHR #029-0230) is anticipated to be truncated by approximately 50 to 60 feet along the property's frontage with Richmond Highway. The circular driveway has undergone several modifications from its original appearance and the original purpose of the circular driveway as a school bus drop off location has been eliminated with the closing of the county school in the mid-1980s. These events indicate that the physical integrity of the historic setting and feeling of the circular driveway feature has been previously diminished and no longer conveys its historic significance. The project would also affect the OMVHS historic property, but the effect would not be adverse.

The Build Alternative would indirectly effect the viewshed of Woodlawn Plantation (029-0056), the Woodlawn Cultural Landscape Historic District (029-5181) and the Sharpe Stable Complex (029-5181-0005) but would not diminish any aspects of integrity as existing conditions have previously diminished the historic setting and feeling of this area due to a major intersection upgrade.

Induced Growth

The ICE Study Areas and surrounding locality are built-out with mature infrastructure. Since the Build Alternative would not contribute to any conditions conducive to induced growth including transportation on new alignment, land use progression, or largely new infrastructure or economic advances that are not already planned in the ICE Study Areas, no induced growth would be expected as a result of the Build Alternative.

Effects Related to Induced Growth

Since no induced growth would be expected as a result of the Build Alternative, there would likely be no effects related to the lack of induced growth.

3.7 STEP 7: ASSESS CONSEQUENCES AND DEVELOP MITIGATION

The No-Build Alternative would not result in substantial indirect impacts to any resource. Therefore, mitigation is not required for the No-Build Alternative. The following sections assess the consequences and mitigation for potential impacts resulting from the Build Alternative.

3.7.1 Socioeconomic Resources

Community and Community Facilities

The Build Alternative would potentially result in the relocation of some housing, community facilities, and businesses and conversion of residential and commercial land use in the Socioeconomic Resources ICE Study Area. In accordance with the Uniform Relocation Assistance and Real Property Policies Act of 1970, as amended, relocated residents would be fairly compensated and relocation resources made available to all qualified relocated residents. Relocated property owners and renters would be provided relocation

assistance advisory services together with the assurance of the availability of decent, safe, and sanitary housing. Relocation resources would be made available to all relocated residents without discrimination. The relocation assistance process does not require that a relocated resident locate in a certain area or to a specific structure; however, community cohesion impacts are generally minimized when there is sufficient replacement housing available and relocated residents, businesses, and non-profit organizations are able to relocate and remain within or in close proximity to their existing communities. Additionally, every effort would be made to reduce right-of-way impacts to adjacent properties during advanced design. A majority of the relocations and right-of-way acquisitions would be located on the edge of the communities; therefore, indirect relocation effects to communities and community cohesion should be limited under the Build Alternative. Additionally, at least one access would be provided per community facility within the access management LOD and no adverse effects to the function of these facilities would occur. By improving an existing highway rather than building on new alignment, impacts to community facilities would be minimized. The Build Alternative would have minor indirect effects to communities and community facilities in the Socioeconomic Resources ICE Study Area.

Temporary indirect effects to socioeconomic resources from temporary road closures, detours and loss of parking during construction would be minimized by informing the affected communities and businesses in advance of when such circumstances would occur, and working with individuals and the community to potentially adjust schedules and identify alternative access.

Bike Paths and Recreational Trails

The Build Alternative would result in enhanced bicycle and pedestrian facilities, creating long-term beneficial impacts to the Socioeconomic Resources ICE Study Area. Additionally, the impacts to existing bicycle and pedestrian networks during construction would be minimized through advance notice of closures and appropriate signage. The Build Alternative could have minor short-term adverse indirect effects and long-term beneficial effects to bicycle paths in the Socioeconomic Resources ICE Study Area.

Economics

The Build Alternative involves potentially displaces 38 commercial buildings on 42 parcels and total acquisition of one commercial property; however, Study Area employment and median household income within the Socioeconomic Resources ICE Study Area would not be impacted. Additionally, only approximately four percent of the total establishments within the zip codes encompassing the Study Area would be impacted. Due to road widening, properties that were previously set back from Richmond Highway could front Richmond Highway after front row buildings are cleared; therefore, businesses and residents may relocate due to the proximity of the proposed improvements. However, the Study Area may experience increased visitors, in addition to other incoming businesses, due to increased travel reliability and connectivity in the area. Short-term construction effects to businesses from temporary detours and lost parking could occur that could cause some customer losses and make deliveries more difficult, these effects would be temporary and minimized by advance notice of closures and directional signing, resulting in minor effects.

3.7.2 Natural Resources

Waters, Wetlands, and Water Quality

Mitigation for water and wetland impacts generally consists of three components: avoidance, minimization, and compensation. Avoiding and minimizing direct effects would also serve to reduce indirect effects. Since the Build Alternative would be on existing alignment, completely shifting the

roadway out of waters and wetlands would not be feasible. However, new stormwater facilities would be constructed outside of waters and wetlands to the extent possible. Minimization of impacts to waters and wetlands would occur by ensuring adequate hydraulic openings are in place so that hydrologic flow patterns are not disrupted, that hydraulic connectivity is maintained to wetlands upstream and downstream, and cut/fill area in wetlands are reduced to the minimal design slope necessary. As design advances, direct impacts to waters could also be reduced by reducing the footprint of the roadway. Compensation would be required for unavoidable impacts to waters and wetlands in accordance with federal and state regulations.

To reduce potential for indirect effects, staging areas would not be located in waters or wetlands, disposal of excess material would not occur in waters or wetlands, and borrow material would not be excavated from waters or wetlands. Implementation of strict erosion and sediment control and stormwater measures during construction would minimize permanent and temporary impacts to waters, and thereby minimize indirect effects as well. Additionally, various control measures could be incorporated into the roadway design and maintenance plans to reduce impacts to wetland hydrology and water quality, including stormwater best management practices, as defined in the stormwater regulations, as a means of mitigating expected impacts to water quality. During construction, the contractor would adhere to VDOT's Road and Bridge Specifications manual, Chapter 40 of Title 3.2 of the Code of Virginia, Virginia Administrative Code (VAC) 2VAC-5-390-20, and other applicable regulations to prevent the introduction and establishment of invasive species.

Floodplains

Design modifications to eliminate or minimize floodplain encroachments to the extent practicable are required by Executive Order (EO) 11988. Since the proposed Build Alternative would primarily be on existing alignment, impacts to floodplains cannot be eliminated, but are expected to be minimal compared to existing conditions. During final design of the Build Alternative, a thorough hydrologic and hydraulic analysis would evaluate the effect of the proposed roadway improvements on stormwater discharge. The hydraulic study would be used to provide adequate design of the hydraulic opening and proper conveyance of floodwaters to minimize potential impacts to the floodplain.

Wildlife Habitat

Potential impacts to wildlife habitat expected as a result of the Build Alternative could be minimized through use of design measures such as reducing the roadway cut/fill footprint. Limiting removal of forest stands along the roadway could serve to reduce habitat losses and related indirect effects to wildlife. Impacts to water quality could be minimized through the installation of new stormwater facilities and use of best management practices, as described in the above waters, wetlands, and water quality section.

In addition, temporary impacts would be reduced through proper location and minimization of staging areas and construction access roads in valuable habitats. During construction, the contractor would adhere to VDOT's Road and Bridge Specifications manual, Chapter 40 of Title 3.2 of the Code of Virginia, Virginia Administrative Code 2VAC-5-390-20, and other applicable regulations to prevent the introduction and establishment of invasive species.

Threatened, Endangered, and Special Status Species

Potential direct loss of threatened, endangered, and special status species is not expected as a result of the Build Alternative. Potential indirect impacts to threatened, endangered, and special status species could be minimized through design measures such as reducing construction footprint, avoiding key

habitat, implementing stormwater and erosion and sediment control measures, and construction of best management practices. In addition, temporary impacts could further be reduced through proper location and minimization of staging areas, construction access roads, and modifying construction techniques in valuable habitats.

If the proposed project is determined to have an effect on threatened, endangered, and special status species, mitigation measures would be further developed following additional coordination with VDGI and USFWS prior to construction. Through the consultation process under the Endangered Species Act (ESA), indirect effects are taken into account and appropriate mitigation measures identified. Consultation would occur before the permit decision, as any mitigation measures, conditions, or restrictions determined necessary by the USFWS would be included by regulatory agencies as conditions of any permit issued. Mitigation measures may include use of time-of-year restrictions on construction, contractor training in recognizing and avoiding threatened, endangered, and special status species and their habitats, or restoration of habitat.

3.7.3 Historic Resources

The Build Alternative would affect one historic resource (the OMOVHS) and would indirectly effect the viewshed of two historic resources (the Woodlawn Plantation and the Sharpe Stable Complex) and one historic district (Woodlawn Cultural Landscape Historic District); however, the indirect effects would not be adverse. Through coordination with VDHR, to recognize the importance of the OMOVHS to the county and local community, VDOT proposes to install two interpretive signs on the property highlighting the architectural and historic education context of the campus. VDOT also commits to working with Fairfax County to conduct an oral history project for the OMOVHS that can be disseminated to the public. No mitigation is proposed for the indirect effects on the remaining historic properties and district.

4. CUMULATIVE EFFECTS

As noted in **Section 2.3** the cumulative effects analysis is based on the process outlined in *Fritiofson v. Alexander*, 772 F.2d 1225 (5th Cir. 1985), as described in FHWA's *Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process* (FHWA, 2014). The following sections follow this direction.

4.1 WHAT ARE THE GEOGRAPHIC SCOPE AND TEMPORAL BOUNDARIES FOR THE STUDY?

The geographic limits for the cumulative effects analysis are the same as the Study Areas described in **Section 3.2.1** of this Technical Report.

The analysis of cumulative effects must consider past, present, and reasonably foreseeable future actions. The temporal boundary used to establish the timeframe for this cumulative effects assessment spans from 1946, shortly before Route 1 became the most heavily traveled through road in Virginia (mid-1950s), to 2045, which is the modeled design year used for the Build Alternative.

4.2 WHAT ARE THE RESOURCES AFFECTED BY THE STUDY?

The resources affected by the Build Alternative would be the same as those resources identified in **Step 3**, discussed in **Section 3.3** of the indirect effects analysis.

4.3 WHAT ARE OTHER PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS THAT HAVE IMPACTED OR MAY IMPACT THESE RESOURCES?

4.3.1 Past Actions

Many of the past actions that have contributed to the baseline for this analysis occurred as part of the mixed used development including retail and other commercial, governmental, institutional, business, and residential development described in **Section 3.2.2**. This development transformed a suburban landscape into an urban environment, resulting in a loss of wildlife habitat and species, impacts to wetlands, streams, and floodplains; and increased levels of air and water pollution. Much of the development does not have any associated stormwater management facilities, since many of the areas were developed before stormwater management requirements were in place. The original development also formed the basis for the substantial level of population growth the region experienced. In association with this growth came an increase in employment and investment in the Socioeconomic Resources ICE Study Area. Past notable projects and transportation resources that have occurred within the vicinity of the Socioeconomic Resources ICE Study Area are listed below and shown on **Figure 1-2**.

- George Washington Memorial Parkway – Listed in the NRHP and maintained by the National Park Service (NPS), the George Washington Memorial Parkway extends for 25 miles from Mount Vernon, past the nation’s capital, to the Great Falls of the Potomac. The landscaped road links historical, natural, and recreational areas. The first sections of the road were completed in 1932.
- Mount Vernon Memorial Highway (VA 235) – Existing since 1933, the state highway runs 5.05 miles of two-lanes between intersections with Richmond Highway in Fort Belvoir and Hybla Valley. VA 235 surrounds the southeastern Fairfax County from Richmond Highway through Mount Vernon communities and connects to the southern end of the George Washington Memorial Parkway.
- Henry G. Shirley Memorial Highway – Construction began in 1941 on the first limited-access freeway in Virginia. The road was completed from Woodbridge, Virginia, to the 14th Street Bridge over the Potomac River between Virginia and Washington, DC in 1952. This highway is a 17.3-mile portion of the current day I-95 and I-395 in Virginia.
- I-95 – Construction started in 1957 on the 178.73-mile interstate, traveling from North Carolina, through Virginia, to Maryland. I-95 extends from Florida to Maine.
- I-495 – Completed in 1964, the 64-mile highway that surrounds Washington, DC is also located in Virginia and Maryland. This interstate is widely known as the Capital Beltway. The Capital Beltway was originally envisioned as primarily a bypass for long-distance eastern seaboard traffic to avoid driving directly through Washington, DC. However, the explosive growth of both housing and business in the Washington, DC suburbs following the Beltway's completion quickly made the Beltway the area's main thoroughfare for local traffic.
- Fairfax County Parkway (VA 286) – A primary highway in Virginia, providing a north-south arterial route in Fairfax County. The first segment of the road opened in 1987 and it was completed in 2010.

- Fort Belvoir – A US Army base founded during World War I. Due to the Base Realignment and Closure Fort Belvoir in 2015, the Fort saw a substantial increase in the number of people assigned or employed at the location. Fort Belvoir is the largest employer in Fairfax County.
- Huntley Meadows Park – A 1,500 –acre County-owned park created in 1975 after three decades of use by the federal government. The park has more than 10 miles of maintained and informal trails, a portion of which is on boardwalk, as well as a visitor’s center and wildlife observation platforms.

The proposed project area spans two watersheds, Dogue Creek and Little Hunting Creek, which both have completed watershed management plans (WMP) as of 2011 and 2005, respectively. The WMPs identify the best projects for improving watersheds from a cost benefit ratio perspective. The Dogue Creek watershed has previously undergone the following stormwater improvement projects: Gristmill Stormwater Enhancements, Banks Property Stream Restoration, Hayfield Secondary School Stormwater Enhancements, Kingstowne Stream Restoration Phase II and III, and Mount Vernon High School Stormwater Enhancements. Gristmill Stormwater Enhancements is the only incomplete project still in development and design in the Dogue Creek watershed. The Little Hunting Creek watershed previous projects include the Bryant Towne Court Stormwater Pond Retrofit, Carl Sandburg Intermediate School Low Impact Development (LID) Retrofit, and the Paul Spring Branch at Gilbert McCutcheon Park Stream Restoration, all of which are completed.

4.3.2 Present and Reasonably Foreseeable Future Actions

Currently, a number of development actions are occurring and/or are planned to occur that could contribute to cumulative effects on resources affected by the project. **Table 4-1** lists the present and reasonably foreseeable future transportation projects that have the potential to contribute to cumulative effects and are either identified in VDOT’s Final 2017 Six-Year Improvement Program (SYIP), MWCOG’s Constrained Long-Range Transportation Plan (CLRP), Fairfax County Department of Transportation’s scoping response, or are on the Northern Virginia Transportation Authority’s (NVTA) Long Range Transportation Plan (LRTP). Pedestrian accessibility, pedestrian and bicycle improvements, shoulder improvements, and bridge replacements projects were excluded as they would have minimal disturbance compared to larger roadway projects.

Table 4-1: Present and Reasonably Foreseeable Future Transportation Projects within the Vicinity of the Socioeconomic Resources ICE Study Area

Project	Status
King Street Station Pedestrian Tunnel	Construction Underway
Eisenhower Avenue Widening and Remove Traffic Circle	Construction Underway
Columbia Pike Streetcar Project from Pentagon City to Skyline Drive area in Fairfax County	Construction Underway
Route 1 Widening from four to six lanes between Marys Way and Annapolis Way	Construction Underway
Richmond Highway from Mt. Vernon Memorial Highway to Pohick Road - Widen from 4 to 6 lanes with raised median	Construction Underway
Lorton Road/Furnace Road from Silverbrook Road to Route 123 Widen to 4 lanes	Construction Underway

Project	Status
Fairfax County Parkway Route 286 & Terminal Road Route 3726	Construction in Fiscal Year (FY) 2018
VA 611 Telegraph Road Widening to 4 lanes, from Hayfield Road to S Kings Highway	Construction Complete in 2030
I-95 Northbound Directional Off Ramp to Northbound Fairfax County Parkway	Design Underway
I-395 Construct 4th Southbound Lane	Design Underway
Rolling Road - Route 638 - Widen to 4 Lanes from Fairfax County Parkway to Old Keene Mill Road	Design Underway
Frontier Drive Extension and Braided Ramps from Franconia Springfield Parkway to Loisdale Road	Design Underway
Route 7100 - Fairfax County Parkway - Construction Interchange at Fair Lakes Parkway (Route 7700)	Design Underway
Route 7 Corridor Improvements Project	Design Underway
Route 1 Install Crosswalks from Fairfax County Parkway to Huntington Avenue	Design Underway
I-395 Express Lanes – Turkeycock Run to Eads Street	Design Underway
Route 286 (Fairfax County Parkway) - Widen from 4 to 6 Lanes from Ox Road to Lee Highway (Route 29)	Future Project
Rolling Road – Widen to 4 Lanes from Delong Drive to Fullerton Road	Future Project
Fairfax County Parkway Corridor Study – multimodal corridor study	Future Project
Lockheed Boulevard and Fordson Road Signal Upgrade	Future Project
Crystal City Transitway: Northern Extension	Future Project

Source: VDOT 2017 SYIP (VDOT, 2017e), NVTA LRTP (NVTA, 2016), FCDOT Scoping Response, and MWCOC CLRP (MWCOC, 2016b)

Fairfax County’s Planning and Zoning Viewer Map, the Richmond Highway Annual Report, and the scoping responses were reviewed to identify other local non-transportation projects (**Table 4-2**) (Fairfax County, 2017b; SFDC, 2016). While there are several planning public projects, no planned private developments have been identified in the Socioeconomic Resources ICE Study Area.

Table 4-2: Present and Reasonably Foreseeable Future Non-Transportation Projects within the Vicinity of the Socioeconomic Resources ICE Study Areas

Project Name	Project Type	Project Description
New Elementary School	Community Facility	FY 2017-2021 Capital Improvement Program includes federal funding for the new elementary school in the West Potomac area, on the grounds of Fort Belvoir
Original Mount Vernon High School Reuse Project	Community Facility	The county is planning a redevelopment project at 8333 Richmond Highway which will utilize the existing facility, a former high school, as well as properties immediately adjacent and behind the site.

Woodlawn Fire Station	Community Facility	The project to renovate/expand the existing fire station was approved as part of the 2015 Bond Referendum.
Transform Former Lorton Prison Into Mixed-Use Development	Mixed-Use Development	A project to redevelop the historic core of the former Lorton Reformatory, also known as the Laurel Hill Adaptive Reuse Area, to mixed-used development.
Bucknell Elementary School Stormwater Enhancements	Stormwater Enhancement	Under development and design
Gristmill Stormwater Enhancements	Stormwater Enhancement	Under development and design
Waynewood Elementary School Stormwater Enhancements	Stormwater Enhancement	Under development and design

Source: FCDOT Scoping Response and Original Mount Vernon High School Reuse Project (Fairfax County, 2016e)

4.4 WHAT WERE THOSE IMPACTS?

Cumulative effects consist of the potential impacts of the alternatives under consideration in the Richmond Highway Corridor Improvements EA and the impacts of the past, present, and reasonably foreseeable future actions. Past, present, and reasonably foreseeable actions have already impacted or have the potential to impact land use and socioeconomic, natural, or historic resources, as does the proposed project. The following discussions illustrate the resources that could potentially be impacted by the Build Alternative and the actions described in **Section 4.4.1** and **Tables 4-1** and **4-2**. These potential impacts are taken into consideration in the following discussions of cumulative impacts to different resources.

4.4.1 Socioeconomic Resources

Past and present actions have been both beneficial and adverse to socioeconomic resources, and it is expected reasonably foreseeable future actions could as well. Past and present growth and development has increased the standards of living for communities, provided for community cohesion, as well as community facilities and recreational resources. Such growth and development has benefited local economies by improving access to markets and customers. Some past and present development actions have resulted in large-scale residential, community facility, and business relocations that adversely affected community cohesion. Transportation facilities have divided and isolated communities, reducing access to neighbors and services. The actions listed in **Section 4.4.1, Past Actions** and **Tables 4-1** and **4-2** have facilitated this growth, division and/or improved the quality of life within the Socioeconomic Resources ICE Study Area. Future actions that lead to growth and development are expected to be beneficial for some, but not for others. For example, growth could increase employment opportunities, but require relocations to accommodate. Current federal regulations require that adverse effects of federal actions consider and incorporate mitigation into decisions that adversely affect communities.

As discussed in **Section 3.2.2**, Richmond Highway was constructed prior to the substantial population increase and associated housing and commercial development that occurred between the 1940s and 1960s. At that time, Richmond Highway was the primary through road in Virginia, acting as a natural barrier. As new neighborhoods were established, they were set back from the natural barrier of Richmond Highway, and typically were located either on the western or eastern side of Richmond Highway.

Therefore, since the expansion of Richmond Highway and increase in associated infill businesses along the roadway, such development had minimal effect on community cohesion.

Future growth and development of the area should also not adversely affect socioeconomics. Due to the lack of vacant land, locality plans propose redevelopment or infill development with considerations for transit oriented development, offering mixed use areas with commercial, government, business, public facilities, open space, and residential combinations. Roadway improvements would include rehabilitation, widening and streetscape efforts, as well as updated pedestrian and bicycle facilities. These types of changes benefit all populations, including minority and low income.

Past and present transportation improvement projects benefit community facilities and recreational resources by improving access. While the Build Alternative would displace community facilities, residents, and business/commercial facilities, efforts would be taken during design to avoid them, or to relocate them within the corridor. Future transportation projects would continue to improve access to community facilities and businesses.

No-Build Alternative

The No-Build Alternative would not improve the existing Richmond Highway corridor. Since its initial construction, Richmond Highway has undergone many improvements and widenings. Congestion on Richmond Highway would continue under the No-Build Alternative. Future growth in the region would increase traffic on the roadway and could affect communities, businesses, and the population that lives along or that uses the roadway, potentially causing residential and business relocations away from traffic congestion and associated air and noise impacts.

Build Alternative

The Build Alternative would widen an existing roadway in a highly urbanized area that has been previously disturbed. Direct impacts would include potential relocations, closing some existing accesses and providing new accesses to parcels in the LOD, and land use conversion and bicycle and pedestrian facilities updates. This area has experienced these changes in the past, due to residential and commercial development and increases in population. The Build Alternative would improve an existing roadway facility, limiting the effects of converting other land uses to transportation compared to improvements on new alignment, thereby limiting indirect effects to communities and community facilities. Although some access routes to parcels may be closed to improve traffic and safety, several parcels have multiple accesses, and each parcel would be provided at least one access. The function of residences, community facilities, and businesses with changed access would remain unaffected.

Widening Richmond Highway would marginally increase the separation distance between communities located on either side, because the relationship between Richmond Highway and adjoining communities has been established and all local road crossings would be maintained, indirect effects to community cohesion would be minor. The relocation of community facilities, business/commercial facilities, and residents would be minimized through relocation assistance, reducing community cohesion impacts. Additionally, the portions of right-of-way impacts would not impede access to the primary use of the community facilities.

Increased commerce and employment from past and present growth and development, including original construction of Richmond Highway, has benefited economic resources in Fairfax County and the Socioeconomics Resources ICE Study Area. Existing congestion reduces access to markets and customers, thereby reducing commerce and employment that could otherwise occur. Continued growth is expected

to have a positive impact to local economies from increased customer demand and long-term employment opportunities. The Build Alternative would potentially relocate business/commercial facilities due to proximity; however, existing business/commercial facilities in the area have experienced relocation changes in the past, and are not likely to be substantially adversely impacted. Future transportation and redevelopment projects could potentially result in residential and business/commercial relocations within the Socioeconomic Resources ICE Study Area.

Local comprehensive planning provides for bicycle and pedestrian updates in the community. Past and present transportation improvements have benefitted bicycle paths and recreational trails by increasing access and existing networks. The reduction in congestion and increase in travel reliability, connectivity, and safety on bicycle and pedestrian networks could positively contribute to present and future community transportation choice. Providing adequate facilities to support bicycle and pedestrian use may reduce roadway vehicle use and improve community connectivity. Future actions have potential to impact bike paths and recreational trails.

Although there is potential for future residential, community facility or commercial relocations due to new front row exposure to Richmond Highway under the Build Alternative, the benefits of decreased congestion under this alternative may attract others to locate along Richmond Highway in the Socioeconomic ICE Study Area. Mitigations efforts during construction would minimize the short-term adverse impacts to socioeconomic resources. Overall, the incremental contribution of the Build Alternative would be both beneficial and adverse for short-term construction.

4.4.2 Natural Resources

From 1946 to the present, Fairfax County has rapidly transitioned from a suburban area to an urban area. Past actions during and after the major urbanization have led to the impaired waters, impacted wetlands and floodplains within the Natural Resources ICE Study Area. Many of these past actions occurred without the benefit of modern stormwater management facilities and/or water quality regulations. Past actions also resulted in the loss and fragmentation of much of the terrestrial wildlife habitat that previously existed within the Natural Resources ICE Study Area. Much of the impairment to wildlife habitat occurred up through the 1980s prior to the enactment of a number of major environmental regulations. Since that time, environmental regulations, natural resource planning, and restoration efforts have reduced adverse natural resource impacts from what could otherwise have continued to occur.

Present and reasonably foreseeable future actions include protections to wetlands, floodplains, water quality, and threatened, endangered, and special status species afforded by federal, state, and local regulations. These protections could limit future adverse impacts to natural resources. Additionally, local comprehensive planning includes natural resource management plans that aim to preserve remaining high valued wildlife habitat and water quality by directing growth to specific areas and densities, with the goal of sustaining natural resources for the future.

Future federal actions, as well as larger private developments, would be established within the framework of these regulatory and technological controls, which should reduce impacts to these resources during future development. Two specific controls for checking future impacts are USACE and VDEQ water quality permits and TMDL-related requirements established by VDEQ. These controls serve to minimize adverse impacts, identify avoidance and other minimization measures, and set limits on the amount of pollutants that are allowed to enter receiving bodies of water.

Since the passage of federal and state regulations to identify and protect threatened, endangered, and special status species, impacts to these species by future actions would be reduced from what the impact would have been if development had been allowed to continue unabated. The anticipated reduction is a result of coordination with agencies responsible for protecting aquatic and wildlife species, consideration of alternatives that minimize and avoid impacts, and conservation and mitigation measures. Therefore, future impacts to threatened, endangered, and special status species would be controlled and limited through this process.

No-Build Alternative

The No-Build Alternative would not improve the existing Richmond Highway corridor. Since its initial construction, Richmond Highway has undergone many improvements and widenings, which have included updating associated stormwater facilities. However, there are still sections lacking any stormwater management features, in addition to sections with outdated features which would not be improved under the No-Build Alternative. Existing untreated or poorly treated stormwater runoff would continue. Additionally, under the No-Build Alternative, animal-vehicle collisions would be expected to continue.

Build Alternative

As previously discussed, past growth and urbanization have diminished natural resources within the Natural Resources ICE Study Area. However, current federal, state, and local regulations and conservation efforts lessen the effects of such development.

The Build Alternative would widen an existing roadway in a highly urbanized area that has been previously disturbed. Direct effects could include impacts to wetlands, streams, and floodplains due to the placement of fill, as well as direct loss of wildlife habitat due to vegetation clearing and earth moving. Indirect effects to these resources could include changes in water quality, increased runoff, changes in hydrologic regime, changes in light regime, introduction of invasive species, alteration of drainage patterns, potential changes in flood flow elevations, animal-vehicle collisions, noise, and potential for oil spills. These direct and indirect effects should be minimized by implementation of best management practices and compensatory mitigation.

Construction and post-construction of the Build Alternative would potentially contribute to minor, localized increases in pollutants and nutrients causing impairment to waterways. Drainage design for the new proposed bridges would be developed in later design phases and is expected to be in conformance with current stormwater regulations in order to minimize effects to natural resources and water quality. Since construction of the Build Alternative would upgrade and replace current stormwater management systems, implementation of the Build Alternative could improve roadway runoff water quality from current conditions.

Because much of the Natural Resources ICE Study Area is developed, wildlife habitat and corridors are highly fragmented. Habitat is most intact along the riverine corridors crossed by Richmond Highway in the Study Area. The Build Alternative proposes to replace or widen bridges at Dogue Creek and Little Hunting Creek, respectively, and a new bridge would be constructed at North Fork Dogue Creek. Existing wildlife movement at these crossings would remain. Consultation with the VDGIF would reduce the potential for adverse effects to up or downstream habitat that supports the State Threatened wood turtle known to use Dogue Creek in the vicinity of the Richmond Highway crossing.

4.4.3 Historic Resources

Damage or loss of historic resources was far more prevalent from actions that occurred prior to the NHPA of 1966. The NHPA of 1966 combined with the establishment of historic resource protection objectives established at the local planning level, have reduced the rates of impacts to historic resources. However, conflicts between the protection of historic properties and development and transportation continue to occur.

Under the No-Build Alternative, increased traffic delays would negatively affect the accessibility to the identified historic resources. While, the Build Alternative would affect one historic resource and indirectly effect the viewsheds of two resources and a historic district, the cumulative effects for the No-Build Alternative and the Build Alternative are not anticipated to be substantial with the protections provided by the Section 106 process for federal actions and by the plan review process by local jurisdictions for other projects. On federal undertakings, implementation of mitigation strategies would be coordinated with VDHR and Section 106 consulting parties (as necessary), reducing cumulative impacts on historic resources that would otherwise occur.

4.5 WHAT IS THE OVERALL IMPACT ON THESE VARIOUS RESOURCES FROM THE ACCUMULATION OF THE ACTIONS?

Since 1946, the ICE Study Area has been in a progression of development, being fully developed in the 1970s, in part due to the adjacency of the area to Washington D.C. The potential for future development is largely limited. Any additional project, due to the lack of vacant land for development, would result in redevelopment activity. The short-term beneficial effect of more jobs and associated expenditures resulting from the Build Alternative is expected to benefit the local communities. Once complete, the project is not anticipated to create induced growth or infill development beyond what was anticipated without the project. The project is anticipated to decrease congestion, increase safety, and provide enhanced bicycle and pedestrian facilities. The Build Alternative would result in a beneficial cumulative effect, with beneficial impacts on local socioeconomics that would be in line with locality plans.

Historically, conversion of natural areas to developed land has had the greatest impact on the area. This development has helped lead to the degradation and/or loss of natural resources over time. The degree of degradation was in part due to the lack of strong federal, state, and local protective regulations in the past. These actions not only impacted the region but maintained the effects of those impacts to the present day such that the environment has not returned to the original state.

Prior to the NHPA and local protective measures, the impact to historic resources through the development of the area was much higher than the potential impacts today. Some historic properties (private and public) may continue to fall into disrepair or be impacted by development in the area. On federal undertakings, implementation of mitigation strategies would be coordinated with VDHR and Section 106 consulting parties (as necessary), reducing cumulative impacts on historic resources that would otherwise occur.

Past and present actions have shaped the current state of socioeconomic, natural, and historic resources within the associated ICE Study Areas, and future actions would continue to shape these resources irrespective of this project. However, since the region is already highly developed, cumulative effects of the No-Build Alternative and the Build Alternative are expected to be minimal. Additionally, current regulatory requirements and planning practices are helping to avoid or minimize the contribution of

present and future actions to adverse cumulative effects for socioeconomic, natural, and historic resources.

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